OLD BURYING GROUND
& TOMBS AT MOUNT PLEASANT CEMETERY
PRESERVATION PLAN

ARLINGTON, MASSACHUSETTS **2018**

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NOVEMBER 2018

TOWN OF ARLINGTON
Dan Dunn, Select Board Chair
Adam Chapdelaine, Town Manager

ARLINGTON CEMETERY COMMISSION, ARLINGTON HISTORICAL COMMISSION & ARLINGTON HISTORICAL SOCIETY

RAY DUNETZ LANDSCAPE ARCHITECTURE, INC.

ACKNOWLEDGEMENTS

This Condition Assessment and Preservation Plan for the Old Burying Ground builds upon the work of staff, agencies, organizations and notable individuals who work to preserve and protect this important cultural resource.

This project was made possible with the gracious support of the people of Arlington through the Community Preservation Act.

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SUMMARY

Along with several important historical sites, Arlington's Old Burying Ground [OBG] holds the history of Arlington's founding and legacy of its cultural heritage. The gravestones, tomb markers and monuments honor the founding members of the community including revolutionary heroes and outstanding figures in our nation's history. Tightly woven into Arlington's historic fabric, the Old Burying Ground is part of Arlington's Civic Block and is listed on the National Register of Historic Places. The goal of the conditions assessment and preservation plan is to present important preservation issues and identify how to address them in order to best protect this valuable historic resource. Included in this Conditions Assessment and Preservation Plan are 5 tombs at Mount Pleasant Cemetery [MPC].

The preservation work began with research into the land use history of the Old Burying Ground, revealing a familiar story of designation, establishment and growth, and eventual neglect mandating its preservation. Pasture land originally owned by townsman Jason Russell was designated as a burial ground in 1724. The land at that time was sparsely vegetated except for a stand of willows along the stream which ran through the middle of the property. The site was actively used for burials for over 100 years and accommodated other civic needs at various times.

Since its establishment and throughout the period of active use, the town desired to construct a proper enclosure but struggled to appropriate the funds to do so. After years of use and then finally suffering from over crowding, the town purchased land for a second burial ground, Mount Pleasant Cemetery in 1843. With sufficient resources, the Town was also able to construct a proper enclosure for the OBG and trees were planted, bringing the OBG to a state of completion.

The present day Old Burying Ground reflects a degree of neglect typical of many historic burying grounds throughout New England. Allocating the funds needed for its proper preservation and maintenance has proven difficult. Turned over grave markers and barren earth are evidence of this neglect, undermining its value to the Arlington community and its importance in Arlington's history.

The team assembled to assess the burying ground was led by landscape architects and included a civil engineer, structural engineer, arborist, and stone conservator. Our goal was to inventory site elements, assess their health and condition, identify safety issues and provide recommendations for their improvement.

Our assessment revealed a range of issues related to neglect and misguided efforts in preservation work. Construction techniques used to repair failing walls exacerbated structural issues found in several boundary walls. The lawn is struggling due to infertile and compacted soils. Shade trees (in good condition) are in need of pruning, while volunteer trees are growing too close to walls and mound tombs compromising structural integrity. The main pedestrian path through the cemetery is eroded and inaccessible according to current Americans with Disabilities Act regulations.

With our understanding of the current issues facing the burying ground and its history, we determined how best to restore and preserve the historic site. Our treatment recommendations are focused on public safety and preservation of the historic fabric of the site. The enclosure of the Old Burying Ground is failing in places, and significant portions of the walls need to be reconstructed. Other sections of walls and mound tombs only require repointing. Our assessment has identified 22 trees as invasive or volunteer material, which are recommended for removal. Soil quality needs to be improved, and shade tolerant turf grasses need to be sown to restore the lawn.

Our prioritized recommendations include an estimate of costs, with safety issues at the forefront. Three priority levels for improvements have been developed: high, medium and low.

Items regarded as high priority are typically related to issues of public safety, structural stability and protection of historic fabric, and should be corrected within one year without resource constraints.

Items listed as medium priority should be corrected within five years and relate to issues including; preventing accelerated deterioration or damage which could lead to higher future costs, replacement of items which are expected to last less than five years, and repair or replacement of items that significantly detract from the appearance of a burying ground.

Low priority items include cosmetic repairs and future considerations that can be delayed at least five years. Stone marker conservation is not addressed in this report.

Maintenance practices at the Old Burying Ground are of utmost importance. Many of the issues facing the Old Burying Ground today are a result of deferred maintenance or inappropriate preservation efforts that have created larger issues for the burying ground. The ultimate success of the preservation of the Old Burying Ground lies in the successful execution of appropriate maintenance practices and life cycle planning. The management guide provides the outline of maintenance requirements to properly manage the historic cemetery and its historic artifacts, and provide a guideline for its preservation for generations to come. ■

INTRODUCTION

The Old Burying Ground is a 1.34 acre lot located within the municipal core of Arlington. Located just south of the Unitarian Universalist Church at the corner of Massachusetts Avenue and Pleasant Street, the burying ground is visible from Pleasant Street, its eastern border. Peg Spengler Way which accesses the Robbins Library parking lot and the Whittemore Robbins House, abuts the burying grounds western border. The Verizon central office building located at 67 Pleasant Street lies to the south of the OBG.

The tombs under consideration at Mount Pleasant Cemetery are located just off Medford Street, Latitude: 42.41707 (42° 25' 1.46" N) Longitude: -71.14891 (71° 8' 56.06" W).

In the Fall of 2007, an extensive survey of the existing conditions of the markers, tombs and walls at the Old Burying Ground was undertaken and documented. The two volume "Conditions Assessment Report for the Markers, Tombs, and Walls in Arlington's Old Burying Ground" report was prepared by Ivan Myjer of Building and Monument Conservation.

In 2015, funding became available for historic preservation in Arlington through the Community Preservation Act, passed by the community in November of 2014. In 2016, the OBG Working Group, comprised of the Cemetery Commission, the Arlington Historical Commission and the Arlington Historical Society, applied for a grant from Arlington's Community Preservation Committee to assess conditions at the OBG and selected tombs at Mount Pleasant Cemetery. On May 1, 2017 Arlington voted to fund the grant.

Preservation planning for Arlington's Old Burying Ground is tied to the cultural significance of the site and the artifacts contained within. These historic artifacts are finite and a deteriorating resource that require preservation and protection from damage by weather, vegetation and visitors, as well as deferred and inappropriate maintenance practices.

While decisions regarding the preservation of artifacts of the burying grounds are a relatively straightforward matter, decisions related to the appropriate overall landscape image of the burying grounds are more difficult because of the changes that have occurred over more than three centuries.

Recommendations in this report follow the 1996 Secretary of the Interior's Standards for the Treatment of Historic Properties. This includes Guidelines for the Treatment of Cultural Landscapes which addresses four treatments: preservation; rehabilitation; restoration; and reconstruction. "Of the four, Preservation standards require retention of the greatest amount of historic fabric, including the landscape's historic form, features and details as they evolved over time."

The specific goals for the Conditions Assessment and Preservation Plan for the OBG and the selected tombs at MPC are as follows:

- Create a plan of action to ensure protection of this resource for future generations.
- Using documentary research, evaluation, inventory, conditions assessment survey and identification of threats to historic elements, three components of the plan will be developed:
    1. Existing Conditions and Assessment
    2. Recommendations for Preservation and Budget Projections
    3. Management Guidelines ■

HISTORICAL DEVELOPMENT

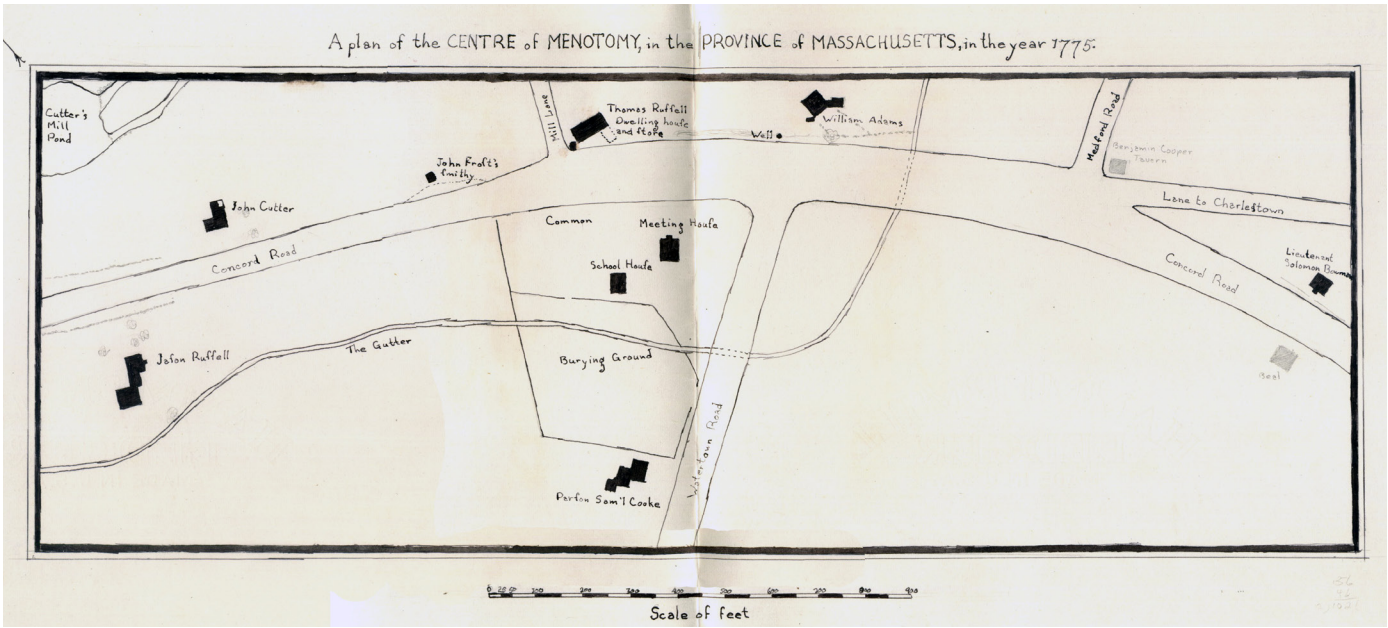
1 PROCESS

The history of the Old Burying Ground has been well documented. Our supplemental research was conducted to gain a greater understanding of the burying ground's physical development. During this research period, we visited Arlington's Historical Society, The Robbins Library and the town of Arlington's Planning Department Archives. We reviewed historic plans, surveys, atlases, aerial imagery, photographs, postcards, and newspapers. We also reviewed written histories, local preservation plans, and relevant master plans. Local historians, maintenance personnel, and neighbors provided further insight into the development of the site. Information regarding the contemporary history of the burying ground was difficult to locate and did not factor into the preservation recommendations.

2 ESTABLISHMENT (1635-1800)

Settlers founded the village of Menotomy in 1635. For nearly a century, these early settlers interred their deceased in the burying ground in Cambridge (what is now Harvard Square). The villagers own burial ground site was selected in 1724, reserved from land owned by Jason Russell. The proprietor's records indicated the townspeople of Cambridge voted "the road leading to Watertown was removed from the northerly side to the southerly side of the land reserved for a burying place." In 1732, after several failed petition attempts to become the Second Precinct of Cambridge, the residents received permission to erect their own meeting house within the burial ground. It is 12 years after the burial grounds designation that we see the earliest date on the gravestone, 1736. The majority of the burials that occurred that year were children.

Providing a proper enclosure for the burial ground was desired during the years of establishment, but its planning proved to be difficult. In 1762, a vote by the townspeople was taken to build a stone wall around the burying ground. Almost a decade later the stone wall had not been completed, but townspeople were solicited to donate stones for its construction and that "any person hath brought stones for the wall to fence the burying-place, shall have the privilege of laying up the stones they have already brought" (Cutter 45). From this description, we understand that the first walls constructed to enclose the burying ground were constructed of dry laid field stone.



Nylander Map, depicting Menotomy Center in 1775

The next 20 years were defined by the events surrounding the Revolutionary War, starting in 1775 with the Battle of Menotomy, which claimed the lives of Jason Russell and 11 other patriots. These patriots were buried in a mass grave in the burying ground "in the clothes in which they fell" (Cutter 70). Many of the British dead from that day were buried in an unmarked grave near the wall in the spot used for the burial of slaves.

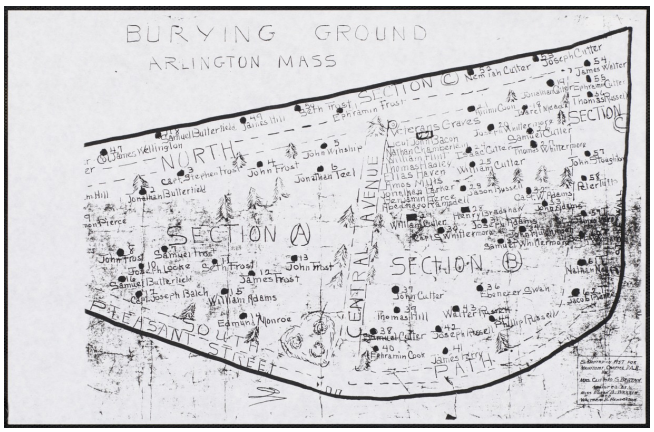
A map depicting Menotomy Center in the year 1775 by Nylander reveals "The Gutter", a seasonal brook that traverses the burying ground presumably where the current gravel path is located. In 1783, a committee was town appointed to complete the wall and to install gates, so that the "burying-place may be sufficiently enclosed" (Cutter 101). In 1799, a vote was taken to build a fence between the burying ground and the Whittemore Estate on the northwest side of the site.

3 ACTIVE ERA (1800-1950)

At the turn of the nineteenth century, the burying ground experienced more active development. In 1807, Arlington was incorporated as an independent town of West Cambridge and several years later, the town voted to allow tombs to be built on the west edge of the burying ground, provided "they should build and maintain a good brick wall" (Cutter 116).

Several structures were introduced to the burying grounds during the first part of the nineteenth century. In 1806, the town voted to construct a building for the Parish in order to 'deposit a hearse' on the south side of the 'Gutter running through the burying ground' on Watertown Road [present day Pleasant Street] (Cutter 113). Shortly after, in 1810, the town voted to move the Central School House within a portion of the land that was not currently being used for burials. This building remained on the property until 1843. Cambridge artist George A. Frost has painted an image of the burying ground illustrating a schoolhouse on Watertown Road [present day Pleasant Street] framed by a stone wall and a brook, hilly topography and grove of trees in the distance. In "Town of Arlington Past and Present", Parker describes that "the only shade in the old burying ground at this time consisted of the bunch of willows shown in this picture." He also suggests that the old hearse house that "stood to the right of the school building" was omitted from the painting as it would have been a distraction (Parker 254).

School in Old Burying Ground in 1810, by Cambridge Artist George A. Frost



1957 Hand Drawn Map of Old Burying Ground
Courtesy of Digital Commonwealth

Records indicate the burying ground was starting to suffer from overcrowding with the development in the first part of the 1800's. In 1831, the town voted to remove the 'old hearse sheds' within the burying ground to capture more space. By 1843, the town purchased the land for Mount Pleasant Cemetery on Medford Street. With this additional land, the rate of burials within the Old Burying Ground slowed significantly. Parker suggests that "the first of the trees now adorning the grounds were planted about the same time the Mount Pleasant Cemetery was prepared for a burying place" (Parker 253). In 1848, the remains of the twelve patriots buried in unmarked graves were disinterred and placed in a stone vault under a new obelisk.

4 PRESERVATION (1950-PRESENT)

Our research found very little information from this period. A hand drawn map from 1957 indicates tree types and locations, paths, significant gravestones and sections located within the burying ground.

5 TIMELINE

Key Dates & Period of Historical Significance

The development of the cultural landscape of Arlington's Old Burying Ground is revealed within its utilitarian features: walls, fences, gates, paths, structures, roads, which all tell the story of how the site was used over time. Towards the middle of the 19th century, the town of Arlington allocated resources to build a substantial wall along Pleasant Street, install new gates, erect a monument, and plant trees, where the Old Burying Ground reached its highest degree of integrity.

This period of historical significance can be used as a reference to guide preservation efforts. It is important to note however, that a single period of historical significance cannot alone guide preservation efforts, as the evolution of the site is not linear and has reacted and responded to the changing needs and changing times. This is evidenced in the following timeline. We use this chronology to help guide our recommendations to preserve and protect this important Arlington resource. ■

1635 Menotomy settled in part of Cambridge. Residents used the Burying Ground in Harvard Square, Cambridge.

1724 Land that was part of the Russell Property was designated as a Burying Ground.

1724 Town voted the "road leading to Watertown be removed from the northerly to the southerly side of the land reserved for a burying-place, Mr. Jason Russell and the neighborhood thereabouts manifesting their desires that it might be so." This road is present day Pleasant Street.

1732 Residents of Menotomy successfully petitioned to become the Second Precinct of Cambridge, receiving permission to build their own meeting house.

1736 Earliest date on gravestone in OBG in *Town of Arlington Past and Present*, Parker suggests the OBG was already in use.

1762 Vote was taken to build a stone wall around the burying ground.

1771 Vote was taken to finish wall construction by May 1772, and that 'anyone who had already brought stones, should have the 'privilege' of laying them. (Cutter) with the implication the wall was constructed out of field stones.

1772 The Parish appropriated money for the wall at the burying ground.

1783 Near end of the Revolution, a committee was appointed to complete the wall and to procure and hang gates so that the burying ground would be 'sufficiently enclosed' (Cutter).

1843 Overcrowding of OBG led to purchase of land for the Mount Pleasant Cemetery.

1843 Substantial wall built along Pleasant street. Installed new gates.

1845 New trees planted in OBG.

1848 Erected monument (19' high granite obelisk) honoring Jason Russell and others killed in Menotomy on the first day of the Revolutionary War.

1938 Hurricane - fallen trees caused damage along Pleasant Street.

ASSESSMENT

1 GENERAL DESCRIPTION

In January of 2018, an existing conditions survey of the Old Burying Ground and selected tombs at Mount Pleasant Cemetery was conducted by Samiotes Consultants, Inc. The survey documents edge of pavements, utilities, walls, curbing, fences, tree locations, and topography. Relative grave marker locations were added to the survey from a map published in Ivan Myjer's 2007 Condition Assessment report. Over a period of several months, the consultant team visited the burying ground to assess the condition of the grounds.

2 EXISTING SITE CONDITIONS

2.1 LANDSCAPE CHARACTER

The Old Burying Ground is defined by the old stone walls which vary in height and material and provide its enclosure. The site is heavily treed and shady, with large stands of evergreen trees located at its center, and many deciduous trees throughout.

The topography within the walls is generally uneven with leaves and water collecting within the small and irregular depressions. The site drains predominantly from west to east, with higher grades along Peg Spengler Way falling toward Pleasant Street. A broad grassy swale traverses through the middle of the burying ground. Areas of erosion and poor drainage in the burying ground were observed.

2.2 ACCESS AND SECURITY

There are two pedestrian access points into the burying ground, one at Pleasant Street and one at Peg Spengler Way. Rusted metal hinges remain as evidence that gates once existed. The eleven-foot wide Pleasant Street entrance is flanked by two granite posts. The four-foot wide Peg Spengler Way entrance features a granite gate post which at one time supported a gate. A rusted two and one half inch diameter metal pipe located on the opposite side of the entrance was most likely a contemporary improvement installed to secure the former gate. Security has not been an issue.

OBG Walls Vary in Their Construction and Condition; View of Brick, Granite Block and Fieldstone Walls Beyond

Granite posts with rail anchors at the western boundary suggest a former fence ran along this location. The posts are in good condition despite rust stains from the anchors. A four-foot height green chain link fence is set along the border of the Verizon property. It is unclear who owns the fence, but it appears to be located on the abutters property.

2.3 CIRCULATION ROUTES AND MATERIALS

A) PATHWAYS

A centrally located path, labeled 'Central Avenue' on the 1957 map (shown on Page 13), connects the two entrances. The path at the Pleasant Street entrance is composed of a ten-foot wide by thirty-foot length section of bituminous concrete paving in poor condition. Without knowledge of its intended use, we assume this section of paving was added to provide a place for maintenance vehicles to park, however during our site visit a contractor's truck was parked on the grass adjacent to the asphalt.

The majority of the central path varies in width and is composed of compacted gravel with gentle slopes at grades less than 3%. Erosion is evident on either side of the path. Near the Peg Spengler Way entrance, the path rapidly ascends two vertical feet in sixteen horizontal feet. The resultant 12% slope does not meet Americans with Disabilities Act requirements for accessibility.

Vestiges of the lawn paths noted as the North and South Paths' on the 1957 map were observed. There is also a lawn path on the east end of burying ground. All lawn paths are in relatively good condition. No "cow paths" that indicate heavy pedestrian use along desire lines were observed in the burying ground.

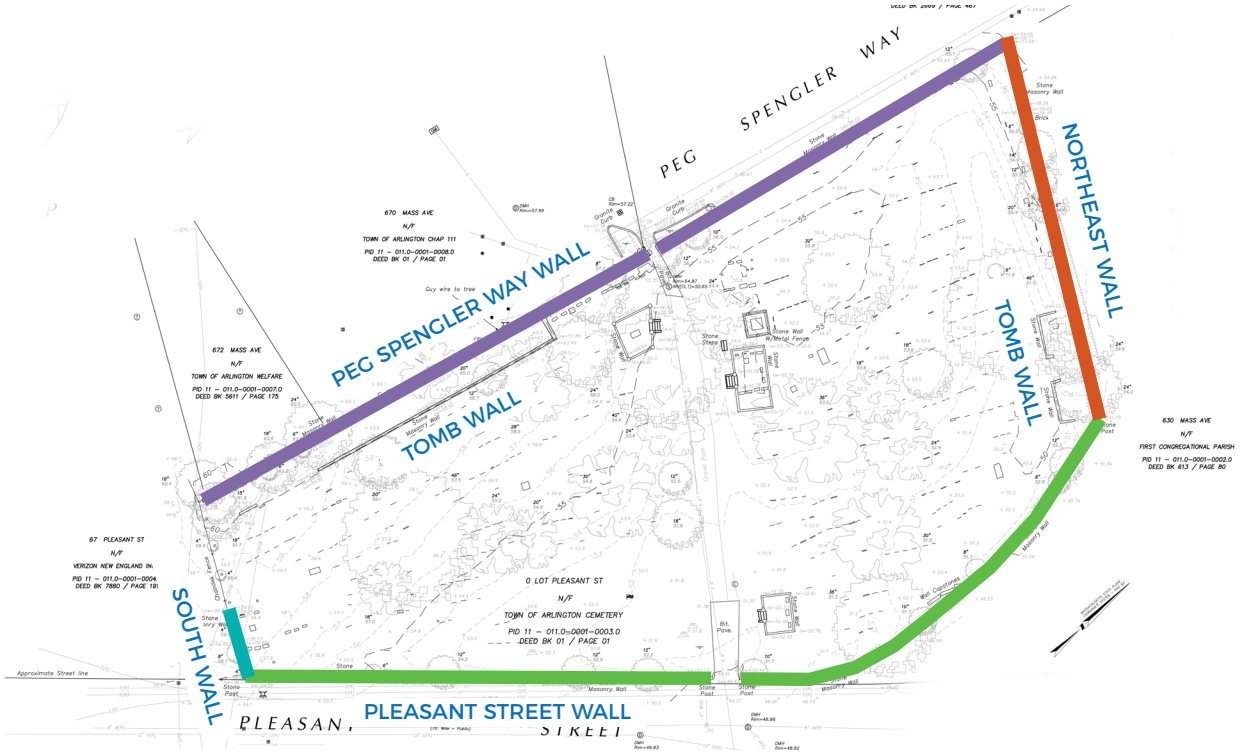
B) STEPS

There are a few granite steps off the central path leading to the Revolutionary War monument. These have settled and are uneven.

2.4 WALLS

The perimeter of the Old Burying Ground is enclosed by varying types of walls, in varying condition, constructed at different times. They are predominantly built out of split block granite, fieldstone and brick. Tomb entrance walls are constructed out of finely cut granite. Some walls are freestanding and others retain earth within the burying ground. Poor repair work on some of the walls is evident. Some of the walls pose safety concerns which are high priority repairs.

Detailed assessments of the walls and tombs prepared by Structures North and Stone Conservationist, Ivan Myjer, are located in the Appendix. A brief summary follows:



OBG Wall Diagram

A) NORTHEAST WALL

The wall along the northeast edge boundary of the burying ground is composed of brick and stone sections. Extensive damage and movement of the wall is evidenced by damaged bricks, joints and bulging. Small volunteer trees and shrubs growing adjacent to the wall have begun to push against the wall and shift the stones. The granite block section has a pronounced outward lean caused by pressure exerted by soil on the inboard side of wall. Outward lean may be reaching critical point where sections of the wall topple. This section of wall is a safety concern.

B) PLEASANT STREET WALL

This wall extends along the Pleasant Street edge and curves to the north moving away from the street. Overall the existing stone wall constructed of split granite block is in good condition with some areas of open and failed mortar joints. On the north side of the Pleasant Street entrance, along the curved section of the wall, there are five coping stones that have been displaced. Four of the coping stones are lying on the ground, some having cracked or broken.

C) SOUTH WALL

There is a low granite block retaining wall located on the east side of this boundary near Pleasant Street. The wall is in good condition.

D) PEG SPENGLER WAY WALL

A three to five foot height field stone wall secures the burying ground border between the northwest corner and the north end of the tombs. This wall changes to brick masonry at the south end. Three quarters of this wall is in poor condition with areas of loose, missing and bulging masonry. Water is entering through cracked and failed mortar, further undermining the integrity of the wall. Substantial moss growth in the mortar joints indicates that the inner mortar has deteriorated to sand. The brick masonry is in a similar state of deterioration as the majority of it is buckled to the point of possible collapse posing serious safety concerns. Roots from volunteer trees have shifted the wall out of plumb, compromising the wall's stability.

Originally dry laid, this wall had no mortar and is not believed to be the height it currently stands. This is a result of efforts to rebuild or restore the wall without consideration of the construction techniques of the past. There are several missing capstones. The capstones located on the ground adjacent to the wall, appear to be from Vermont and are not likely original.

Masonry Side Walls of OBG Northeast Tombs Have Shifted

2.5 MOUND TOMBS

The mound tombs in the Old Burying Ground are a type of crypt construction that was common in New England in the first half of the 19th Century. Mound tombs are crypts that are constructed in the side of a hill, or covered with earth after construction, to form an artificial hill. The construction can either be a field stone mortar laid wall that changes into a brick barrel vault above grade or it can consist of straight sided, mortar laid granite walls that are capped with large flat pieces of granite to form a roof. The OBG contains both types of tombs, while the Mount Pleasant Cemetery contains the latter.

A) OBG TOMBS

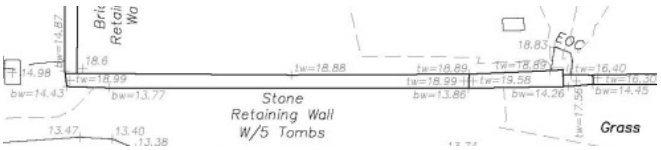
Fifteen tombs line the southern half of the western boundary wall. The southern tomb has a separate front wall which appears to be pulling away from their vaults, leaning slightly. Mortar joints at these tomb walls are in poor condition. A small opening into the southern row tomb is evident. The northern tomb end wall is retaining a small amount of soil and bowing outward. Marble tomb plaques have been set in the brick wall rather than the tombs. It does not appear that tomb side walls have adequate footing as evidenced by the shifting.

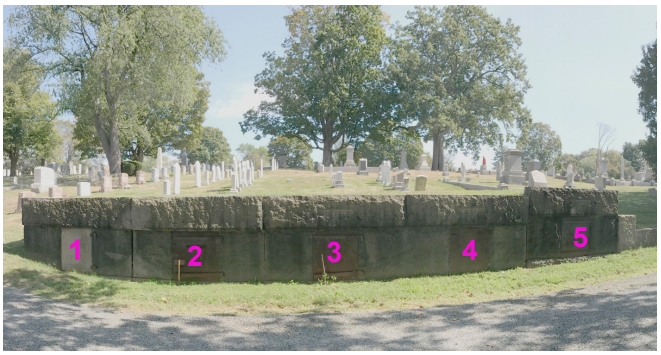
Four tombs are located adjacent to the Northeast wall. The front walls of the tombs are in good condition but masonry side walls have shifted. Three of the four metal tomb doors have broken or damaged hinges.

Small movements in the tomb doors allowed for viewing of the interior of two tombs. Wet mortar joints were observed along with open mortar joints in the rear stone wall.

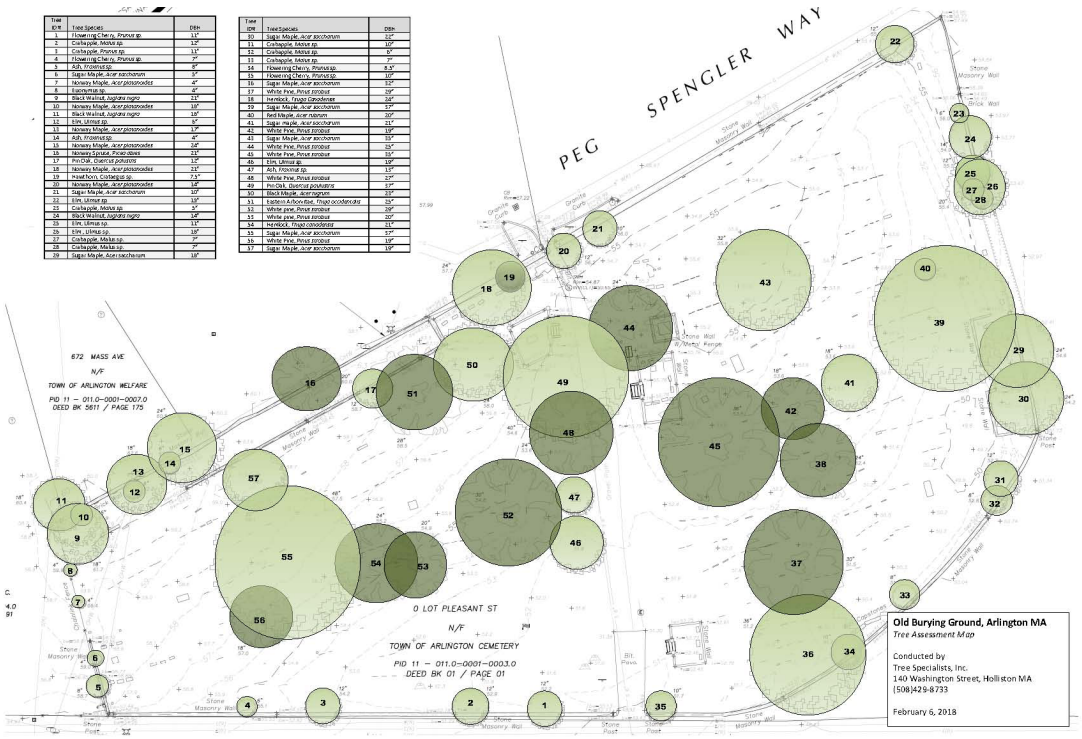
B) MPC TOMBS

The row of five mound tombs are constructed with masonry walls with stone slab ceilings. The top of the tombs are covered with turf and soil. Brick masonry located on the west side wall is failing. There are many open joints that are missing mortar. The front stones are shifting outward. Four tomb doors are rusted and inoperable, and one tomb door is missing.





Five Mound Tombs at Mount Pleasant Cemetery



OBG Tree Inventory; Evergreen (Dark Green Circles) and Deciduous (Light Green Circles)

2.6 SITE AMENITIES

A) TRASH RECEPTACLES AND SEATING

None.

B) SIGNS

There is one older metal sign inside the Pleasant Street entrance that is set on a metal post in the lawn a few feet off of the pedestrian path. Despite facing Pleasant Street, the sign cannot be read from the street, and is oriented away from the path. The sign provides general information about the Old Burying Ground.

B) FLAGPOLES

One unlit white painted flagpole at 25' height is located near the main entrance. The history of its installation is unknown, but appears to be operational and in good condition.

2.7 UTILITIES

A) LIGHTING

The burying ground is devoid of lighting which is appropriate for this historic space. Street lights along Pleasant Street cast ambient light into the grounds. A small light, with historic character, is mounted on a granite post just outside the wall along Peg Spengler Way. It is unknown if it is functional.

B) OVERHEAD WIRES

Two overhead wires cross over the southern end of the burying ground leading from two utility poles located just outside the southwest corner. It is unknown what function they serve.

C) WATER SUPPLY

No source of water is located inside the burying ground.

D) SEWER

The presence of drainage/sewage utilities through the burying ground is evidenced by associated manholes. It is assumed that the brook that once traversed the site is piped through the site via the combined storm/sewage pipe.

2.8 SOILS

The soils at OBG are infertile, poorly drained and compacted. These conditions have affected the quality of lawns and the health of trees. A detailed soils report prepared by Pine and Swallow, soil scientists, is included in the Appendix.

OBG Lawn in Poor Condition

2.9 VEGETATION

A) TREES

There are 57 trees located within the burying ground including Pin Oaks, Sugar Maples, Ash, Black Walnuts, Arborvitae, Elms, Hemlocks, Norway Spruce, White Pines, Cherries and Crabapples. Invasive species observed include Mulberry and Norway Maples. The trees vary in condition and have been assessed for safety, visibility into the burying grounds and their impact on structures. Several stumps remain from trees previously removed from the burying grounds. A detailed report conducted by certified arborists is included in the Appendix.

Of the 57 trees assessed: 81% are deciduous and 19% are evergreen, 77% are non-flowering and 23% are flowering, 88% are non-invasive and 12% are invasive. Of the total material, 21% was observed to be growing too close or directly into site walls.

B) SHRUBS

Shrub material was observed along the northern half of the northeast wall. Shrubs are a maintenance concern and are not considered appropriate in this historic landscape.

C) LAWNS

Observations of the area indicate the lawn is not well established. Pine and Swallow evaluated the topsoil and subsurface drainage conditions in relation to the relative success of the turf. Successful turf and optimal growth depend on a number of factors; compaction levels, drainage conditions, planting media, nutrient status and maintenance.

Findings revealed that the primary issue for the poor turf conditions at the OBG is lack of maintenance. pH levels are very low which reduces nutrient uptake and availability of nutrients. Bare ground areas have not been re-seeded and soil fertility is low. Thatch has reduced the ability for root penetration and the grades allow for ponding of water. In addition, the lawn appears to be in shade for many hours of the day.

The soil analysis further reveals that the existing topsoil is too fine grained than typically recommended for parkland, resulting in excess wetness after precipitation events. Topsoil for use in park areas must be well-drained, but also provide adequate organic matter and nutrient holding capacity to support quality turf. Overly dry soil conditions appear to be contributing to failure of turf at the eastern side of the project site.

2.10 MAINTENANCE

Town maintenance of the burying ground includes the mowing of lawns, removal of tree branches, snow clearing and leaf removal. The general appearance of the burying ground is that it is well maintained despite some fallen branches, small leaf piles and pine needles. Grave markers have been repaired on an as needed basis. ■

OBG + TOMBS AT MP CEMENTERY PRESERVATION PLAN

CONDITION ASSESSMENT PLAN

LEGEND

Access & Security

1. Pleasant St. entrance - gate missing
2. Peg Spengler Way entrance - gate missing, exceeds ADA

Circulation Routes & Materials

3. Bituminous path

Structural Elements

4. Pleasant Street wall - mortar missing from joints
5. Coping stones lying next to wall, some broken
6. Northeast wall - stone - area of bulging
7. Northeast wall - brick
8. Interior tomb walls
9. Peg Spengler Way wall - stone - moss growth
10. Peg Spengler Way wall - brick
11. South wall

Fences

12. Granite posts, missing rails

Site Amenities

13. Existing sign
14. Flagpole

Grading

15. Low area

Vegetation & Landscape Character

16. Bare lawn
17. Trees growing into wall

PHOTOGRAPHS 1 PRESERVATION PLAN

1. Pleasant Street entrance

2. Peg Spengler Way entrance

3. Bituminous path

4. Pleasant Street wall - mortar missing from joints

5. Coping stones lying next to wall

6. Northeast wall - stone, area of bulging

7. Northeast wall - brick

PHOTOGRAPHS 2 PRESERVATION PLAN

8. Interior tomb walls

9. Peg Spengler Way wall - stone, moss growth

10. Peg Spengler Way wall - brick

11. South wall

12. Granite posts, missing iron rail

13. Existing sign

14. Flagpole

15. Low area

16. Bare lawn

17. Trees growing into wall

RECOMMENDATIONS

1 OVERVIEW

The following details our recommendations for the protection, stabilization, preservation and/or restoration of the Old Burying Ground. The general recommendations provided in this section are supplemented by detailed reports included in the Appendix.

2 RECOMMENDATIONS

2.1 LANDSCAPE CHARACTER

Depressions in the lawn should be filled in, to create a smooth even surface. Large deciduous and evergreen trees should remain and pruned to allow for more light to reach the lawn at the ground plane.

2.2 ACCESS AND SECURITY

The Old Burying Ground should remain open to the public. New gates matching the former historic gates should be installed at the entrances only if historic photos are discovered. If historic evidence is not discovered, the wall openings should remain ungated.

The wood rail and granite post fence should be restored at the southern boundary. The chain link fence located on the abutter's property should be removed.

2.3 CIRCULATION ROUTES AND MATERIALS

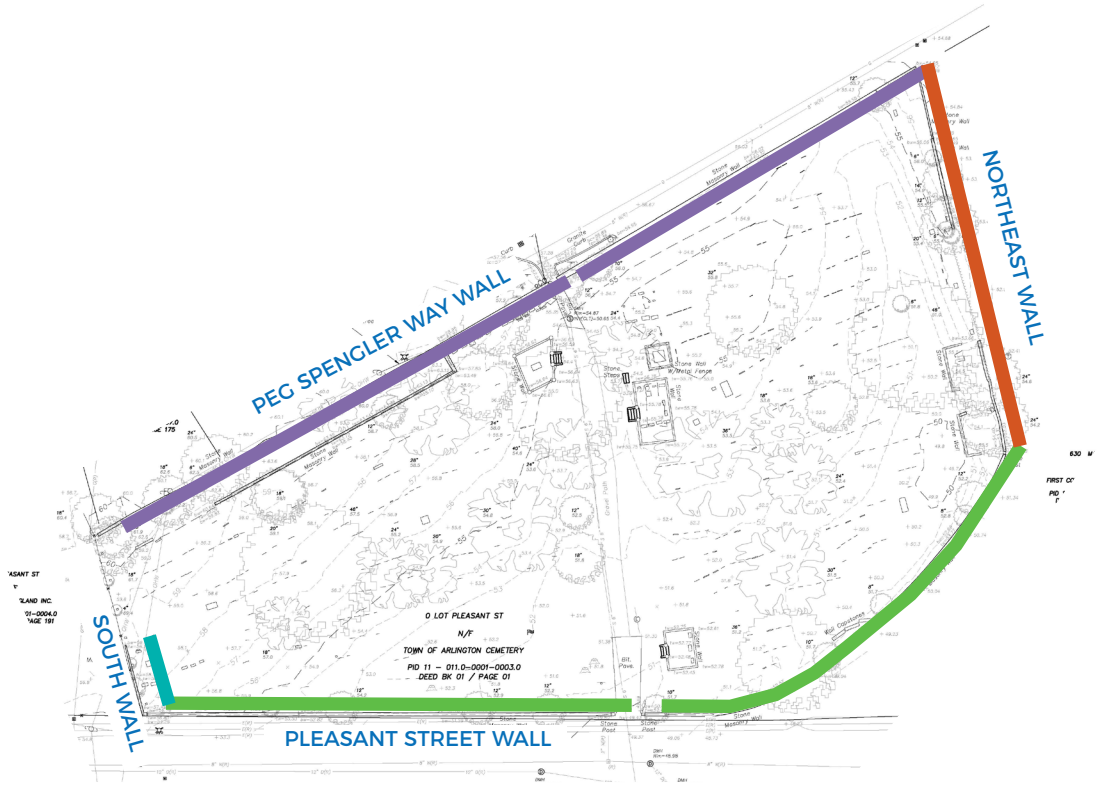
A) PATHWAYS

Central Avenue should be resurfaced with stabilized stone dust and graded with slopes less than 5% to comply with the latest ADA and Massachusetts Architectural Access Board standards. The path should maintain a 5' maximum width, and edged with metal edging. Excavation for new paths should not exceed an 8" depth and care should be given during grading to protect existing tree roots and gravestones. All maintenance vehicles should be kept outside the burying ground.

Secondary lawn paths throughout the Burying Ground should continue to be maintained with regular mowing. Minor areas of erosion should be repaired, by filling with topsoil and seeding as they occur.

B) STEPS

The granite steps at the family plot off of the central path require resetting.



Wall Diagram

2.4 WALLS

The following summary of recommendations gives an overview of needed repairs for the perimeter walls. The recommended repairs to each section of wall are consistent with the historic character of that section and the manner in which the wall was constructed. The structural integrity for each section should be established in areas where it has been compromised. In all cases, the removal of small trees and shrubs growing in and adjacent to these walls is recommended. Detailed recommendations prepared by Ivan Myjer and Structures North are included in the Appendix.

A) NORTHEAST WALL

The granite block section of the Northeast Wall that has a pronounced outward lean should be disassembled and rebuilt. Granite units should be salvaged and reset in their original position with an appropriate footing installed. Reset granite blocks that are out of plumb and repoint the remaining stable sections of the granite block wall. Rebuild brick sections of the wall have portions that are missing or toppled with matching brick. Remove shrubs growing into the wall. Coordinate wall work with tomb repairs. Wall work adjacent to tombs shall follow recommendations per the 'Addendum to 2018 Arlington's Burying Ground Tomb Assessment Report' located in the Appendix.

B) PLEASANT STREET WALL

Repair and reset displaced coping stones. Repoint open and failed mortar joints in granite block stone or between stones and coping stones with matching mortar. Remove soil and debris from under coping stones and repack the void with granite shims and mortar.

C) SOUTH WALL

No work to the low granite wall is recommended.

D) PEG SPENGLER WAY WALL

Rebuild portions of the wall that are in poor condition from below grade. Remove and salvage wall stones and coping stones for reuse. Rebuild this wall with a concrete core and footing, using existing stones as veneer. Remove failing mortar and repoint with historically appropriate mortar and joint profile from stable wall sections to remain.

Dismantle unstable brick portions of wall and rebuild using salvaged brick and salvaged granite coping stones. Reset marble plaques in their original position. Wall work adjacent to tombs to follow recommendations per the 'Addendum to 2018 Arlington's Burying Ground Tomb Assessment Report' located in the Appendix.

Existing Sign

2.5 MOUND TOMBS

A) OBG TOMBS

Remove trees and shrubs growing on top of the tombs or adjacent to them. Maintain lawn cover at tomb fronts and side slopes and replenish soil as needed.

Reconstruct unstable tombs and repoint remaining walls. Fill large gaps in tomb walls as required with stones and soil. Comply with state regulations on the handling of human remains prior to reconstruction work. All work to follow detailed recommendations per the 'Addendum to 2018 Arlington's Burying Ground Tomb Assessment Report' located in the Appendix.

B) MPC TOMBS

Reconstruct unstable tombs and repoint remaining walls. Fill large gaps in tomb walls as required with stones and soil. Comply with state regulations on the handling of human remains prior to reconstruction work.

2.6 SITE AMENITIES

A) TRASH RECEPTACLES AND SEATING

Do not provide seating and trash receptacles inside the Old Burying Ground.

B) SIGNS

The existing sign within Old Burying Ground should be repaired and refinished and remain in place. New signage should include identification, regulation, orientation, and interpretation and should be located outside the burying ground entrances.

C) FLAGPOLES

The existing flagpole should remain in situ and refinished as long as flag protocols are followed. If not, the flagpole should be relocated to another suitable location.

2.7 UTILITIES

Reset all utility manhole frame and cover elevations within the Central Path to meet new grades.

A) LIGHTING

Lighting within the Burying Ground would be inappropriate and should not be added.

B) OVERHEAD WIRES

Relocate overhead wires to outside the Old Burying Ground.

C) WATER SUPPLY

A new water supply is not recommended inside the Burying Ground.

D) SEWER

Provide a new manhole cover at the existing sewer manhole with historic information about the 'Old Gutter'.

2.8 SOILS AND LAWNS

Protection of headstones is paramount to protect delicate resources during lawn renovation. Fill existing depressions in existing lawn areas to create smooth and even surfaces. No excavation is permitted without supervision from a licensed archeologist. Remove thatch from existing lawn areas. Amend soils to promote lawn growth. Sow shade and drought tolerant seed mixtures in disturbed areas.

A detailed soils report prepared by Pine and Swallow is included in the Appendix.

2.9 VEGETATION

A) TREES

Provide a crane outside the burying ground for all tree work and protect headstones from damage with plywood. Remove tree limbs posing safety concerns and invasive trees and trees growing near walls and tombs. Treat trees for control of insects and disease and remove trees as detailed in the Tree Assessment Report prepared by the Tree Specialists, located in the Appendix.

B) SHRUBS

Remove all shrubs from the Burying Ground. ■

3 PRIORITIES AND COSTS

The following budget presents opportunities and estimated costs for all capital improvements delineated in these recommendations. Items are listed in approximate order of priority in 2018 dollars.

High

Repair/rebuild northeast wall *	$182,800
Repair/rebuild Peg Spengler Way wall *	$1,506,300
Repair Pleasant Street wall *	$16,600
Repair tombs at OBG	$262,200
Remove selective vegetation	$9,000
Provide ADA compliant path	$20,000
Prune trees	$27,000
	$2,023,900

Medium

Reset granite steps	$900
Repair tombs at MPC	$26,800
New trees	$15,400
Restore lawn	$20,000
	$63,100

Low

New granite posts at entrances	$4,500
New wooden rail fence	$1,200
Relocate overhead wires	$2,000
Provide new signage	$5,000
New decorative utility cover	$5,000
	$17,700

TOTAL	**$2,104,700**

* The wall estimates reflect the highest value in a range of costs for repairs presented by Structures North. For a detailed description of the work and the associated price range, see their full report located in the Appendix.

RECOMMENDATIONS MASTER PRESERVATION PLAN

LEGEND

Access & Security

1. Restore granite posts
2. Address boundary

Circulation Routes & Materials

3. Install ADA compliant path
4. Reset granite steps

Walls

5. Northeast wall, rebuild, repoint
6. Pleasant Street wall; repoint, reset coping stones
7. Peg Spengler Way wall; rebuild, repoint, reset coping stones
8. Repair and repoint tomb walls

Site Amenities

9. New signage
10. Refinish flagpole

Utilities

11. Relocate overhead wires
12. Adjust/replace utility cover

Soils & Lawns

13. Repair lawn

Vegetation

14. Remove shrubs
15. Remove volunteer growth along perimeter walls
16. Remove invasive trees

MANAGEMENT

1 OVERVIEW

The importance of the Old Burying Ground to the Arlington community is reflected in well-kept lawns, other components kept in a good state of repair and an inviting informative sign system. A well maintained site tends to discourage vandalism. The following maintenance management guidelines should serve as a general guide. Specific changes in these recommendations may be required over time. Primary responsibility for this maintenance is with the Town of Arlington.

2 MAINTENANCE MANAGEMENT

2.1 GENERAL CLEAN UP

Leaves, paper, trash or debris should ideally be removed on a weekly basis. Leaves should be removed during the fall and the grounds cleared of fallen branches.

2.2 CIRCULATION

Existing paved areas should be kept free of snow and ice and remain passable at all times and as safe as possible. Spread sand on icy spots and steps. The use of excessive amounts of salt for deicing is not recommended because it is toxic in excessive quantities to trees and other vegetation. Repair cracks every 5 years or until stone dust path is installed.

Once the stone dust path is installed, clean paths twice a year. Rake stone dust as needed to smooth out any depressions that may have occured. If sections of the path become significantly depressed, or washouts occur, replenish the stone dust and re-compact in an even manner. Add a new layer of compacted stabilized stone dust to the cemetery paths every five years.

2.3 WALLS

Because the Old Burying Ground is located in a northern temperate climate, structural elements are subject to a wide range of temperatures. This thermal stress requires regular examination and subsequent maintenance of structural elements. Inspect for cracked mortar, loose bricks, broken stones and other movement annually.

2.4 MOUND TOMBS + MARKERS

Remove vegetation from top of mound tombs and maintain lawn.

The deterioration of the markers at the Old Burying Ground is evident. Stone is subject to natural weathering, which has become accelerated by atmospheric pollution. Porous stones like marble, sandstone and limestone are more subject to the effects of weathering than nonporous stones like granite. The prohibition of gravestone rubbings should be continued because the process can leave wax or ink and cause surface losses. Inspections should be conducted every season to check for damaged stones and any other cases of accelerated deterioration due to weather and vandalism.

Fallen or tilting headstones should be reset in an upright position. Left in place, a leaning headstone is more liable to be damaged by lawn mowers. Deterioration may be accelerated because they may absorb moisture from the ground or collect rainwater.

2.5 SITE AMENITIES

A) SIGNS

The sign should be cleaned annually and refinished as needed.

B) FLAGPOLE

The American Flag should be raised daily or displayed only on holidays. If the American Flag is left flying at night, it must be lit. The flagpoles should be assessed annually for structural and paint integrity. Repair as needed.

2.6 VEGETATION

A) SOILS

Soils should be monitored and tested for pH and fertility every 3 to 5 years to determine fertility changes made with basic treatments and to give a bench mark for further soil improvements. It takes 3 to 5 years for the soil and the basic treatments to reach equilibrium.

Liming: Lime serves several important functions. It is of particular value in correcting the acidity of the soil. It also changes the structure of the soil, hastens bacterial action in the soil, aids in the liberation of plant foods

which otherwise remain in the soil in unavailable form, hastens the decomposition of organic matter and supplies a small amount of calcium, which is one of the essential plant foods. Ground limestone should be applied every 3 to 5 years as required to bring lawn areas to the preferred 6.0-6.5 pH level. If a lime application is necessary, apply it 2 to 3 weeks prior to fertilizing. Lime should not be used in combination with animal manures or with nitrogenous fertilizers, as it causes the rapid release of ammonia. Lime should be applied either in early spring or late fall, with early spring (April) preferred.

Fertilizing: Soil tests are required to determine fertilization needs. Lawn areas should be fertilized a minimum of twice a year to maintain a healthy lawn. Light, frequent applications of readily available Nitrogen fertilizers are preferred over heavy, infrequent applications. Lawns in this area generally require 0.5 pounds of Nitrogen per 1,000 square feet per growing month. The chemical formulation of all fertilizers proposed for use should be checked by a stone conservator prior to use to prevent potential damage to gravestones and other artifacts. Fertilizer should be applied with a mechanical spreader when turf is dry. This work should be either contracted out by the Town or performed by Town maintenance crews.

B) TURF MANAGEMENT

Seed is recommended for establishment of lawn. Seed mixes should incorporate improved low maintenance, drought resistant and shade tolerant seed varieties. The best time to plant a lawn is between August 15 and October 1 to reduce weed infestation and maintenance requirements.

Rehabilitating existing lawn areas: The lawn in historic burying grounds needs to be rehabilitated with care because of gravestone and bone fragments just below the surface of the ground. Weed species should be removed. The soil should be loosened by power rake or hand raking. Rototilling is not recommended because of potential damage. Fertilizer and lime should be added as recommended by soil analysis. Mounds should be regraded and depressions filled with topsoil. Bare spots should be seeded, top-dressed and rolled. Water must be provided to maintain a sufficient moisture level to establish grass. Protect existing gravestones during these operations.

Mowing: Mow every ten to fourteen days to an average height of 3 inches. The most serious issue is the routine removal of grass in the immediate vicinity of gravestones and tombs. Power mowers can scar and break stones. The types of stone used in gravestones tend to be softer and more easily damaged than granite. The best current solution is to mow with lawn mowers to within twelve inches of gravestones and tombs and then use weed whips [rotating nylon filament trimmers] to trim the remaining area. The use of weed whips is permissible at granite and brick, using the thinnest string (.80) available. Metal hand trimmers should not be used because they can abrade stone. At the marble gravestones, and perhaps slate, grass should be removed from the bases of the stones using hand trimmers to maintain a vegetative free zone adjacent to gravestones.

2.6 VANDALISM

Vandalism and other problems should be reported promptly to the Town of Arlington. ■

APPENDIX

Conditions Assessment Report
For the Markers, Tombs and Walls
In Arlington's
Old Burying Ground

Executive Summary

In the fall of 2017, Building and Monument Conservation was retained by the Town of Arlington to update the Conditions Assessment Report of the structures located in the Old Burying Ground completed by Building and Monument Conservation in 2008. The focus of the 2017 update was on the reassessment of the tombs and the perimeter walls, but the grave markers and monuments were also reviewed.

Review of grave markers

In the nine years since the previous assessment, a significant amount of work has been completed towards the repair and maintenance of grave markers. Many of the highest priority markers identified in the 2008 report have been repaired and reset. A handful of markers remain to be addressed but, as many of these are located along the perimeter of the burying ground adjacent to the walls that also need repair, it does not make sense to repair or reset these markers until the much-needed work on the perimeter walls has been completed. The markers closest to the walls will need to be removed while the walls are being repaired and placed in storage – preferably within the burying ground. The location of each stone that is removed should be marked on the map created specifically for the 2018 Master Plan.

March 2018 Tomb Reassessment

Overview of Construction

The mound tombs in the Old Burying Ground are a type of crypt construction that was common in New England in the first half of the 19th Century. Mound tombs are crypts that are constructed in the side of a hill, or covered with earth after construction, to form an artificial hill. Typically, the entire structure, with the exception of the front wall, is covered with soil that is seeded with grass or other plants in order to keep the soil from eroding. The purpose of the sod is to protect and stabilize the masonry. The vault generally takes one of two forms. It can either be constructed with field-stone walls and a brick vault that begins below grade or it can consist of mortar laid coursed granite walls that are capped above grade with large flat pieces of granite to form a roof.

The Arlington Burying Ground contains both types of tombs. Looking from the exterior, it is not always easy to tell which tombs contain brick vaults and which are roofed with granite slabs unless the soil has eroded and the structure is exposed. The freestanding tombs on the north side of the burying ground have brick vaults while the row of contiguous tombs on the west side have flat granite roofs. The front walls of the tombs in the OBG are very similar to each other in terms of style and construction regardless of the

type of construction used to form the crypt. The tomb fronts at the OBG are very plain without inscriptions or ornamentation. The fronts are constructed from three massive granite slabs – two that form the wall on either side of the door and one that spans the top of the door opening.

To construct a mound tomb, a hole was dug into the side of a hill, or into the ground and then a foundation was laid for the four walls. On top of the foundations, walls were constructed either from rubble stone or cut blocks set in mortar. For tombs with brick barrel vaults, the spring line of the vault was started below grade so that the earth could act as a restraint for the vault - to resist the natural tendency of arches to spread. For tombs with granite roofs, the walls were extended about two feet above grade and then the long pieces of granite were set across the side walls. The massive pieces of granite that form the front walls were set in front of the granite roof or brick vault with the upper lintel unit projecting at least a foot above the roof in order to form a forward barrier for the sod. The floors were usually created from tamped earth or brick about four feet below grade. The interior walls were parged with lime stucco and/or whitewashed. At the end of a line of contiguous tombs, or on either side of a single tomb, stone retaining walls were laid to keep the sod from eroding down the steep sided mound formed by the tombs.

Town records as codified in "History of the Town of Arlington, Massachusetts 1635-1879" by Benjamin and William Cutter" state that "permission was granted in 1810 to the inhabitants of the parish to build tombs in the northerly part of the cemetery on condition provided that they also "build and maintain a good brick wall on the same" The walls currently behind the tombs on the north are granite but there are brick walls a bit further to the west which are currently lying on the ground.

There is a remarkable consistency from burying ground to burying ground throughout New England in the dimensions of the crypts and the manner in which they were constructed. The interior space is always entered through a narrow door just wide and tall enough to allow a casket to be slid in. Usually, but not always, there are steps down to the floor constructed from brick or granite blocks. The doors were often set on cast iron hinges placed in holes drilled into the granite and secured in place with molten or tamped lead. Doors constructed from slabs of marble or bluestone were common in the early 19th century though less of these have survived than the iron doors because of the fragility of the stone.

Some tombs were constructed with stone shelves built into the interior walls to support the caskets. Others were constructed with low stone dividers onto which the caskets were stacked while others do not have any casket supports at all.

All of the tombs that were examined in the Arlington Burying Ground contained human remains but only fragments of the wood caskets. The Seth Wyman tomb contained at least nine adult skulls. In all cases, the human remains were scattered around on the floor making entry very difficult.

Conditions:

The interiors of the three tombs that were entered in 2008 were in very good condition at the time. A re- inspection of the Seth Frost and James Hill tombs in 2018 did not find any changes to the conditions.

Front Walls of Tombs

Mound tombs generally have a common problem that is a direct result of the manner in which the front walls were constructed. The problem is more acute in tombs with brick vaults than those with granite roofs because the builders did not have an adequate way of anchoring the front wall of the tombs to the masonry that forms the brick vaults. When anchors between the front walls and the vaults were used, they were generally long wrought iron rods secured to the front wall units at one end and to the granite slab roof or the brick vault at the other. This worked reasonably well for granite roofed tombs where the anchor could be set into a hole in the granite but the brickwork in the barrel-vaulted tombs provided less of an opportunity to make a durable connection because, while granite works well in tension, the lime mortar between the bricks in the vaults does not. A second issue that affect both types of tombs is that over time, the wrought tie iron rods eventually corrode and fail.

As a result of this fundamental design flaw all of the front walls of the tombs in the Arlington OBG are pulling away from the brick or stone vaults. The forward tilt of the walls has resulted in a gap between the sides of the vault and the front walls as well as between the top of the vaults and the front walls. In Arlington the problem is not yet acute enough to warrant rebuilding of the front walls.

The builders of the contiguous tombs on the west side of the burying ground attempted to compensate for this problem by anchoring all of the front wall capstones to each other with iron cramps. While these anchors certainly slowed the rate of movement they were not able prevent it and all of front walls on the west tombs have tilted forward.

The problem is more acute on the north elevation because as noted earlier, the brick vault construction provided less opportunity to anchor the fronts to the vaults.

The top of the walls tend to move away from the vaults because of a combination of factors ranging from settling of the foundation to ice forming in the wet soil behind the cap stone. As the wall moves outward the rate of movement slows considerably because, as the gap widens, less water is trapped. The flow of water through the gap between the capstone and the vault however can be detrimental to the foundations and floors of the tombs.

The problem can be addressed in the early stages of movement by installing anchors and sealing the gap with masonry. In the advanced stages, there are few options other than taking the front walls apart and rebuilding them with anchors.

Rear Walls of Tombs:

In 2008, problems were noted at the perimeter walls of the burying ground but there was some uncertainty as to how these problems might be impacting the structure of the tombs. To clarify the relationship between the rear walls of the tombs and the perimeter walls that abut the tombs, a series of probes and investigations were undertaken as part of the re-evaluation of the tombs in 2018. The results of the investigation are contained in the addendum to this report.

Retaining Walls on the Sides of the Tomb:

The side walls of the mound tombs are important because they function as retaining walls to keep the soil on top of the vaults from washing down the steep slopes of the mound. These walls vary in the way they were constructed as well as in the materials that were used. Not all of the side walls appear to be original.

It does not appear that any of the sidewalls were constructed with an adequate footing – a factor in why all of them have shifted. The tomb sidewalls can tolerate a certain amount of displacement and still function as intended because the soil fills the gaps created by the wall movement.

The north retaining wall on the row of tombs on the west perimeter of the OBG is very close to collapsing. The wall is very bowed and the coping stones on top of the wall have fallen on to the roof of the first tomb.

Recommendations:

General:

1. Remove trees that are growing on top of the tombs or adjacent to them.
2. Initiate a monitoring system to monitor the outward movement of all the tomb fronts. A yearly tape measure survey would suffice if the measurements were taken using fixed points on the wall and on top of the tombs.
3. Keep all tombs permanently covered with soil and grass. Replenish sod that has eroded on an annual basis.

Priority 1

- Repair the north sidewall on the west tombs by dismantling and rebuilding.
- Repair the perimeter wall that forms the rear wall for the west tombs by dismantling and rebuilding the displaced sections of wall. (See addendum for specific repairs to the west perimeter wall.)

Priority 2

- Repoint the west perimeter wall sections that do not require rebuilding.
- Rebuild low side walls that are displaced.

- Install additional flat stones and soil in the gaps where the front walls have been displaced.

Note on Working with Human Remains

All of the tombs very likely contain human remains. In the tombs that were inspected, the remains were scattered on the floors of the tombs. If the west perimeter walls are part of the structure of the tombs, steps will have to be taken to either remove, cover or bury the remains before work can commence.

Introduction to Perimeter Wall Assessment

In 2008, Building and Monument Conservation completed an assessment of the perimeter walls of the Old Burying Ground in Arlington. In 2017 we were asked by the Town of Arlington to update that assessment. A resurvey was undertaken in Feb of 2018.

Aside from a very small amount of work on the west elevation adjacent to the gate, no work has been completed on the perimeter walls in the intervening ten years. The conditions however have gotten dramatically worse in every respect. Walls that were beginning to lean are now leaning dangerously. Trees adjacent to the walls that were starting to displace masonry are now larger and the amount of displacement has grown.

As a result of the resurvey, the priorities and recommendations from 2008 have revised. In 2008 the walls with the greatest need for repair were labeled “high” priority. In 2018 sections 1,2 and 5 have been reprioritized as “urgent/critical” because not only is the historic fabric in danger of being lost but the collapse of the wall by collapsing could represents a safety hazard.

In 2008 there was a concern that the section of wall along the west elevation directly behind the mound tombs on the west elevation was also part of the structure of the tombs. In 2018 the interior walls of the Seth Frost and James Hill tombs were examined, and probes were undertaken from the interior and exterior. The results of that examination are contained in the addendum to this report along with a section by section description of the work that is required.

General Recommendations

1. Remove all trees and shrubs that are adjacent to the walls and/or close enough to the walls to damage them as they mature. Smaller/desirable trees can possibly be replanted further from the walls.
2. Work with a civil engineer to determine the extent and condition of existing subgrade wall footings. For sections of the wall that have to be rebuilt, the engineer can determine of the existing footings can be reused or must be replaced.
3. Work with a historic masonry specialist to specify the means and methods to retain the historic integrity for sections of the wall that have to be rebuilt or

repaired. The historic masonry specialist will specify a historically appropriate mortar, mortar profile, mortar tooling and color.

4. Evaluate state archeological requirements in locations were subsurface work is to be completed.

Overview

The perimeter of the Old Burying Ground is enclosed by several types of stone wall - each constructed at a different time. The earliest surviving section may be a small portion of collapsed brick wall along the north side of the burying ground. The rest of the wall sections appear to have been constructed during a 110-year period beginning around 1840 and ending around 1950. There was a partial reconstruction of a small section of wall along the west perimeter in 2006 but not additional work has been completed since then.

It is difficult to match the existing walls to the dates in the historic documentation. For example, town records state that in 1767 a vote was passed to fence the burying – place with a stone-wall and do it by subscription. In 1771 the minutes state that it was voted that the wall to fence the burying-place be accomplished in twelve months from May 27, 1771. In 1783, a committee was chosen to complete a wall around the burying place and also empowered to "procure gates and hang the same so that said burying place may be sufficiently enclosed". It is not clear if the walls were built in 1783 because in 1843, town records state that "a good and substantial stone wall was built around the new and old cemeteries …with suitable gates." The curved wall along the east perimeter is a "good and substantial stone wall" but the style of the granite work is more in keeping with granite walls from the 1860's than with those from the 1840's.

Generally, walls can be dated by the type of setting mortar or the complete absence of mortar but, as all of the existing wall sections contain modern Portland Cement mortar, it is difficult to determine if a particular section of wall has simply been repointed in the 20th Century with cement mortar or if it is an entirely new wall. While it is possible that some sections of the existing stone walls along the west boundary were constructed in the 18th or 19th centuries, it is more likely that the stones from earlier walls were incorporated into the later walls. As noted previously, only the fragments of the collapsed brick wall along the northern boundary appear to be traceable to a specific reference in the town records as permission was given in 1810 to construct tombs along this side of the burying ground as long as a brick wall was also constructed behind the tombs.

The perimeter walls vary considerably in the manner in which they were constructed but not in the type of materials that were used to construct them. The predominant material is granite or in some cases granitic field stones. After granite the only other major wall component is brick. The manner in which granite was used to construct the walls is a study in the use and working of this stone. For example, the south perimeter boundary consists of granite posts that were worked by hand to produce narrow sections that project from much larger sections below ground. These above ground sections still contain the wrought iron attachments for wooden rails. The east wall that curves to form part of the north wall is constructed from pieces of granite that were worked by hand to

produce relatively flat top and bottom beds with sides that are perpendicular to the beds. The stones on the west wall, in contrast, are either exactly as they were found in nature or minimally worked. The cap stones on the east wall were extensively worked by hand to produce a sloped wash surface as well as rockfaced sides with tooled margins. Those on the west wall however were simply split with plugs and feathers and mauls; no attempt was made to work the stones further. The west wall, which is laid up in cement, is probably later than the east wall but it is very possible that the cap stones on the west wall predate those on east wall. As with so many structures in New England, the cap stones could have been salvaged and re-used from an earlier wall located either at the burying ground or in some other place.

All of the walls serve to mark the boundaries of the burying ground and some may serve additionally as retaining walls or, as the rear support walls of in-ground tombs constructed parallel to the walls. It is not clear that all of the sections that are currently serving as retaining walls were constructed with that use in mind. It is very possible that the grade inside the burying ground was changed so that it is higher on the inner side of the wall now than it was when the walls were constructed. This change in grade could account for some of the bowing and outward lean of the walls.

The end walls of the tombs that form the boundary on the southern extent of the west wall have an unfinished quality about them that suggests that they were not originally intended to be seen. These wall sections were constructed primarily from brick with occasional sections or courses of split granite. It is possible that there was at one time an outer facing of stone or soil that was removed when the adjacent parking lot was constructed.

Since there is no single wall type, there can be no single recommendation for the repair, restoration and maintenance of the perimeter walls. While there are some common causes of deterioration such displacement resulting from the growth of trees and shrubs adjacent to the walls, there is no single remedy. The repairs to each section of wall must be consistent with the historic character of that section and just as importantly the manner in which the wall was constructed. In many cases, the repairs that have been made to the walls in the last seventy to eighty years have undermined not only the historic appearance of the walls but also their structural integrity. This has been done by introducing mortars into dry laid walls or by introducing cement mortars into walls built with earlier lime-based mortars. In some cases, these interventions can not be reversed and there is no choice but to continue to maintain the walls in the same manner as they have been since Portland Cement was introduced.

The side walls at the ends of the row of tombs on the west elevation run perpendicular to the perimeter wall and appear to be attached to the perimeter wall. The condition of these walls has deteriorated significantly over the last ten years. These walls are critical for preventing soil erosion and maintaining the historic appearance of the tombs, but they are not critical to the structure of the tombs. In contrast, the side walls of the tombs on the north elevation tombs the walls may be providing some structural stability for the brick vaults within the tombs in addition to keeping the soil cover over the tombs from eroding.

A consistent layer of soil cover is vital for the stability of the brickwork as the soil insulates the bricks and mortar from freeze-thaw damage and erosion of the mortars.

Section by Section Conditions Assessment and Treatment Recommendations

The Arlington Burying Ground perimeter walls change in terms of materials, type of construction and/or condition every 50 to 100 feet. The varying wall types and conditions warrant separate assessments and treatment recommendations for each section of wall. The burying ground map created for this project contains a key to the section numbers below. The recommended repairs described for each section could in most cases form a discrete project or could be combined with repairs to other sections to form a larger project, depending on the available funding.

Section 1: North Elevation with slight return on West. Ref 2008 map for exact location

Description of Materials and Construction

- Split granite block construction.
- Holes from plugs and feathers - a type of tool used to split granite visible at edges of blocks.
- Wall functions as retaining wall.
- Top and bottom beds of blocks worked to a smooth finish.
- Sides (joints) perpendicular to beds.
- Faces of blocks split and pitched.
- 3 Wrought iron cramps – a type of anchor – visible at top of wall.
- Blocks set in Portland Cement mortar and pointed with cement mortar indicating possible 20th century construction or rebuilding.
- No coping stones at top of wall – water entering through upward facing joints.

Condition of Wall

- Pronounced outward lean to the wall caused by pressure exerted by soil on the inboard side of the wall. Outward lean has increased dramatically over the last ten years and may be reaching critical point where sections of the wall topple.

Recommended Repairs

1. Disassemble approximately 35 linear feet of this wall, salvage granite units and reset them in their original position using concealed stainless steel anchors.
2. Condition of existing footing has not been determined. A new footing may be required.
3. Repoint sections of the wall that are not rebuilt.

Section 1 Priority – Urgent/critical

Section 2: West Elevation. Please see 2008 map for exact location.

Description of Materials and Construction

- Rubble wall construction with split granite coping stones.
- Constructed from two wythes of granitic and shale fieldstones with small stones set in center.
- Inner and outer facing wythes are pointed with cement. Small stones set between the inner and outer wythes that are not packed with cement.
- Given the absence of mortar at the inner core it is possible that the wall was constructed with lime mortar that washed away over time. To stabilize the wall it was then packed with cement mortar from both sides. The relative height of the wall (+/- 60") compared to its thickness however is unusual for either a dry laid wall or a lime mortar set wall – it is also possible that the wall was originally constructed as it appears now.

Condition of Wall

- Bowing and displacement of wall as well as cracking and debonding of mortar joints has increased dramatically over the past ten years.
- Wall is displaced in two areas by trees.
- Section at north end of wall is in danger of collapsing.
- Tree root infiltration at foundation/footing level is undermining the integrity of the wall.
- Multiple generations of repointing mortar are visible.
- Virtually all mortar is de-bonded and no longer functioning as intended.
- Water is entering though cracked and failed mortar and further undermining the integrity of the wall.

Recommended Repairs

- Remove trees and roots adjacent to wall.
- Rebuild entire wall from below grade – Roughly 150 linear feet of wall.
- Number, remove and salvage coping stones for reuse.
- Remove all markers adjacent to wall prior to starting any work and store in a safe location for reinstallation in original location after wall rebuilding is complete.
- Salvage all wall stones for reuse.
- Evaluate rebuilding wall with poured concrete core and original stones as facing on either side.

Section 2 Priority – Medium High overall. For northern portion of this wall in danger of collapse, the priority is Urgent/Critical.

Section 3: West Elevation. South of entrance. Roughly 52 feet from entry to side wall of tomb. Please see map for exact location.

Description of Materials and Construction

- Rubble wall construction with split granite coping stones identical to section 2 (except for recently rebuilt portion)
- Constructed from two wythes of granitic fieldstones with small stones set in center.
- Inner and outer facing wythes are set in cement with small stones set between the wythes that are not packed with cement.
- Section adjacent to opening rebuilt circa 2006

Condition of Wall

- Wall displaced by tree at mid section.
- Tree root infiltration at foundation undermining wall.
- Multiple generations of repointing mortar.
- Virtually all mortar is de-bonded and no longer functioning as intended.
- Water is entering though cracked and failed mortar and further undermining the integrity of the wall.
- Section at north adjacent to opening in wall rebuilt with modern Portland cement mortar. Granite cap stones were lost while in storage. New matching cap stones required.

Priority Section 3 – medium. Additional Repairs – located in addendum

Section 4: West Elevation. From start of tomb to transition to brick and stone. Please see map for exact location

Description of Materials and Construction

- Wall may form part of rear wall of the contiguous mound tombs located inboard of the wall.
- Split granite rubble wall with plug and feather marks.
- Large units of stone set in mortar with small galleting stones to fill gaps.
- Split granite coping stones.

Condition of Wall

- Wall bulging and displaced in two locations.
- Voids between stones where mortar has failed and stones are displaced.
- Water is entering through cracked and failed mortar and further undermining the integrity of the wall.

Recommended Repairs and/or Maintenance to Section 4

Please see addendum for recommendations

Priority Section 4 – Low

North End of Section 5: West Elevation. Please see 2008 map for exact location

Description of Materials and Construction

- Section forms the rear of the south mound tombs on the west elevation.
- Hybrid brick and stone construction.

Condition of Wall

- Major bowing where tree is pushing wall from outside the burying ground – possibly on private property.
- Displacement where tree had been growing from tomb side but was cut down. (Photo 42)
- Displacement caused by small tree growing from wall.
- Open and failed mortar joints

Recommended Repairs and/or Maintenance to Section North End of Section 5

Please see addendum for recommendations

Priority - Medium

South End of Section 5: West Elevation. Please see 2008 map for exact location.

Description of Materials and Construction

- Free standing brick wall construction with split granite coping stones.
- Brick wall may be tied into the rear wall of the stand alone mound tomb in front of the wall.
- Six marble tomb markers are set into wall on interior side.
- Part of wall functions as retaining wall for soil on the interior.

Condition of Wall

- Wall is bowing and leaning out.
- Wall is in danger of collapse at mid section.
- Wall plaques have become dislodged.
- Extensive mortar joint failure.

Recommended Repairs and/or Maintenance to South End of Section 5

Please see addendum for recommendations

Priority – Urgent/Critical

Sections 6 and 6a: South Elevation. Please see 2008 map for exact location.

Description of Materials and Construction

- Section consists of granite posts that at one time had wood rails that spanned between the granite posts. Wrought iron anchors for rails are still present.
- At the east end is a low granite retaining wall.
- Chain link fence adjacent to granite posts appears to be on abutter's property.

Condition of Wall

- Granite posts are in good condition but wrought iron rail attachments are rusted.
- Low retaining wall at east end is in good condition.

Recommended Repairs and/or Maintenance to Section 7

- Discuss with abutters installing a more historically appropriate fence where in place of the existing chain link fence.
- Restore appearance of burying ground fence by placing wood rails between granite posts.
- Remove small trees and bushes at east end adjacent to retaining wall.

Priority Sections 6 and 6a - Low

Section 7: East Elevation – South Section. Please see 2008 map for exact location.

Description of Materials and Construction

- Section constructed from split and dressed granite blocks with granite coping stones set in mortar with granite shim stones.
- Coping stones tooled at top surface to create wash with rock faced finish and tooled margin at sides

Condition of Wall

- Wall section is generally in good condition but mortar joints between coping stone units are open and failing.
- Coping stones are wider than wall in some locations.
- Water entering through open joints between the coping stones has deteriorated the mortar below the coping stones and dislodged the small stones that support the coping stones
- Small trees and shrubs growing adjacent to the wall have begin to push against the wall and shift the stones.

Recommended Repairs and/or Maintenance to Section 7

- Remove small trees and shrubs growing adjacent to wall.
- Repoint 100% of the upward facing joints between the coping stones to full depth using a compatible mortar.
- Clean out soil and debris from under the coping stones and repack the void with mortar and small shim granite shim stones.

Priority Section 7 - Medium

Section 8: East Elevation – North End. Please see 2008 map for exact location as well as photographs 12, 55 and 56 for conditions.

Description of Materials and Construction

- Section eight is constructed in an identical manner as section seven except that it curves to the north.

Condition of Wall

- Five coping stones are displaced – four of which are lying on the ground.
- 1 short coping stone is broken and a second is cracked.
- Some open and failed mortar joints.

Recommended Repairs and/or Maintenance to Section 8

- Repair cracked and broken coping stones with epoxy and stainless steel pins.
- Re-set displaced coping stones.
- Repoint open and failed mortar joints with mortar that matches existing.
- Clean out soil and debris from under the coping stones and repack the void with mortar and small shim granite shim stones.

Priority Section 8 - Medium

Section 9: West Elevation. Please see 2008 map for exact location as well as photographs 7 – 11, 13, 14 for conditions.

Description of Materials and Construction

- Long rectangular split granite blocks set on small stone shims.
- Wall may be part of rear of freestanding tomb.

Condition of Wall

- Two mature trees growing out of the top of the tomb are pushing on the wall and causing the upper course of stone to shift and lean towards the north.

Recommended Repairs and/or Maintenance to Section 9

- Remove trees and roots.
- Define property line with adjacent church.
- Coordinate work on wall with work on the tomb in case the perimeter wall is supporting the rear wall of the tomb.
- Reset stones that are out of plumb.

Priority Section 9 - Low

Section 10: North Elevation. Please see 2008 map for exact location.

Description of Materials and Construction

- Sections of the brick wall are missing – There are fragments of older brick walls lying on the ground.
- Tall shrubs have grown over the toppled and missing sections.

Condition of Wall

- Fragmented

Recommended Repairs and/or Maintenance to Section 10

- Remove shrubs and build historically appropriate wall from brick masonry.

Priority Section 10 - Low

Section 11: North Elevation. Please see 2008 map for exact location

Description of Materials and Construction

- This section consists of brick retaining walls of varying heights.
- The low section of wall has a modern bluestone coping.
- The medium high section has a cement wash for about 10 lin. ft.
- The high section has granite coping stones.

Condition of Wall

- The high section of wall is leaning out and is cracked.
- The low section of wall has extensive mortar failure.

Recommended Repairs and/or Maintenance to Section 12

- Remove existing wall sections as well as plantings and replace with a historically appropriate brick retaining wall. Salvage and reuse granite cap stones.

Priority Section 11 – Medium

Conditions assessment of

Five contiguous tombs located in Mount Pleasant Cemetery

Arlington, Massachusetts

In February 2018 Ivan Myjer of Building and Monument Conservation examined the five contiguous mound tombs located near the entrance to Mount Pleasant Cemetery. The purpose of the examination was to assess the condition of the masonry and develop recommendations for the preservation and maintenance of the structures.

All the tombs were examined from the exterior and one tomb- the second from the left – was examined in the interior by inserting a small camera into opening created by the gap between the iron door and the granite door jambs.

Description of Tombs

The five contiguous tombs, which form an interdependent masonry structure, were probably constructed at the same time. The three on the right side have the year 1843 carved into the face of the capstone along with the family names of the owners. The two on the left side do not have dates or names inscribed on the capstone but since they were constructed in the same manner and with the same materials as the three dated tombs on the right, it is reasonable to assume that they were constructed at the same time.

The five tombs have separate burial chambers and entrances but share partition walls and in one case a portion of the front wall. The tombs were constructed by digging a large ditch roughly four feet below grade and then constructing the individual rooms from random laid field stone. The walls were extended above ground and then capped with large granite slabs to create a roof. The facades of the tombs were closed with massive granite slabs to form a simple unadorned front with a small opening only large enough to pass a casket through. Each of the five tombs has its own separate façade except for tombs three and four in which a large granite unit spans between the two tombs.

Four of the entrances retain their original iron doors attached to iron straps mounted on pintels set in the granite door surround. The first tomb on the left is missing its door – the entrance has been sealed with masonry covered in cement stucco. The contiguous granite slab roofs of the were covered with soil - sloped at the ends to form the distinctive mound shape. Retaining walls were constructed at either end to keep the sloped soil cover from eroding. On the left side, (facing) the retaining wall is constructed from bricks and mortar with granite cap stones. On the right side there is a partial retaining wall constructed from granite field stones and cement mortar. It is not possible to determine if either retaining wall is original.

The floors of mound tombs constructed in New England in the first half of the 19th century were either paved with brick or stone or left bare. Stone shelves were sometimes built into walls to support the caskets but in other instances brick supports laid on the floor were used to elevate the

caskets. Tomb number 2 – the second from the left – contains the remnants or two or more caskets that appear to have been set on brick supports laid on the bare ground.

Conditions:

The tombs are generally in good condition. The capstones for tombs 1 and 2 have shifted outward between 1.5 and 2 inches. The cause of the movement is likely the expansive force of water freezing in the soil layer behind the capstone. Currently, no gap is visible between the end of the roof slabs and the shifted capstones probably because soil is covering the gap.

The two side walls are in very poor condition. The one on the right appears to be a makeshift repair from granite fieldstones and cement mortar. The one on the left is a well-constructed brick and mortar wall with granite coping stones. Generally, these types of sidewalls do not have adequate footings and can be easily dislodged or toppled. The left sidewall is leaning outward and the mortar bond between it and the front wall is broken. There is extensive mortar deterioration in the upper courses of brick and the course of bricks directly below the coping stones is completely debonded. The sidewalls serve more than a decorative purpose, the serve to keep the soil on the top and sides of the mound tomb from eroding. The soil layer in turn helps stabilize the tombs and it limits the amount of water that enters the gaps between the granite roof slabs. Rebuilding the sidewalls is vital to keeping the soil in place and limiting water infiltration into the tombs.

The masonry interior walls of tomb 2 looked to be in good condition despite the shifting of the capstone on the exterior. The four remaining iron doors are in poor condition. The straps that secure the sheet metal doors to the pintels are corroded and separating from the sheet metal. One strap is missing from each of the doors to tombs 4 and 5. While doors to tombs 4 and 5 appear to be locked or corroded in a fixed closed position, the doors to tombs 2 and 3 are slightly ajar – secured from opening fully by an iron bar hammered into the ground. As with the similar door closures at Arlington's OBG, the stake in the ground is not secure enough to keep a determined vandal from entering the tombs. All of the tombs contain human remains and some might also contain objects such as hair clasps or silver plated hinges that could be removed.

Treatment Recommendations:

Short Term 1 to 3 years

1. Monitor the movement of the capstones at tombs 1 and 2. as well as the deterioration at the left retaining wall.
2. Repair the iron doors – consult with an iron specialist. Install a more secure door closure system to prevent vandals from entering the tombs. Inspect the tomb interiors while the doors are being worked on.

Longer Term 4 - 6 years

1. Reset the capstones at tombs 1 and 2 and secure the capstones to the granite roofs with stainless steel anchors. As part of the same project, rebuild the left retaining wall with an adequate footing and also attach it to the front wall and if possible the granite roof with

stainless steel anchors. Replace the missing iron door from Tomb 1. Inspect the interior of the tombs when the doors are being replaced.

The five tombs are structurally interdependent, sharing common walls and a continuous front wall. The iron door at Tomb 1 is missing but the pintels remain in the granite.

Tomb 2 interior. The random laid walls as well as the granite slab ceiling are in view. The floor is covered with the remnants of wooden caskets.

The brick retaining wall is leaning outward and the upper courses are debonded.

The metal doors are badly corroded and the straps securing them to the hinges are either missing or detaching from the sheet metal. The door closure system – a bar hammered into the ground is not very secure.

Addendum to 2018 Arlington Burying Ground Tomb Assessment Report:

Probes and Investigation to Determine the Structural Relationship Between the Perimeter Walls and the Rear of the Tombs with Recommendations for Repair

Executive Summary:

In August and September of 2018 Building and Monument Conservation completed probes and assessments of the perimeter walls of the Old Burying Ground. The goals of the investigation were to determine the structural relationship between the rear walls of the three sets of mound tombs and the perimeter walls of the Old Burying Ground.

During the recently completed tomb and wall assessment sections of the perimeter walls were observed to be highly deteriorated and/or tilting outward. The proximity of the walls to the rear elevation of the tombs raised a concern that rebuilding of the walls might impact the structure of the tombs and/or expose human remains. Determining the relationship between the perimeter walls and the tombs is a key component of developing an accurate scope of work for the repair of the tombs.

Summary of Assessment Methods:

The initial proposal was to probe the perimeter walls along the west boundary of the burying ground by removing bricks, stone and mortar from the parking lot side of the sections wall in order to determine if the rear walls of the tombs were distinct constructions that were separate from the perimeter walls or, interwoven with the perimeter walls. The first set of probes proved to be inconclusive because, without knowing the configuration and exact locations of the tomb roofs, it was impossible to determine if the probes were above or below the structural support of the granite slab roof. The approach was revised to include opening three of the tombs to take measurements from the interior and then probe the wall from inside the tomb rather than from the exterior. This approach allowed us to establish the dimensions of the tombs as well as the thickness and exact location of the support walls of the tombs relative to the positioning of the perimeter walls in various locations.

Summary of Major Findings:

West Row of 10 Contiguous Mound Tombs

The short answer is that the perimeter wall along the west boundary of the Old Burying Ground is structurally part of the rear walls of the ten contiguous mound tombs along the western edge of the cemetery. This however does not mean that the interiors of all of the tombs, or the structural integrity of the tombs will be impacted by repairing and/or rebuilding the west perimeter wall. The height of the perimeter wall varies from about 30 inches above grade to 48 inches above grade. The roofs of the tombs are located about 15 inches above grade. This means that the major part of the perimeter wall is located above the roofs and walls of the tombs. The sections of the perimeter wall that are above the roof line of the tombs can be safely removed without impacting the tombs or exposing

the interior. Only the removal and repair of the sections of the wall located between the ground and the underside of the tomb roof (roughly 15 to 20 inches) would potentially impact the tombs. A further consideration is that not all of the west perimeter wall needs to be disassembled- roughly one third of the wall can be repointed without disassembling and rebuilding the wall from grade. A detailed scope for each section of the west perimeter wall is contained the next section.

The investigation also revealed that the granite slab roofs of the tombs are supported almost entirely by the masonry walls between the tombs that run perpendicular to the rear walls of the tombs. Since most of the perimeter wall is above the line of the tomb roof therefor removing it will not affect the structural integrity of the tombs. The sections of the perimeter wall that are integral to the rear wall of the tomb are the sections located below the bottom of the flat granite slab roofs of the tombs. (Ref Ska 2 below) With adequate precautions, it should be possible to remove and rebuild the tilting and deteriorated sections of the west perimeter wall without undermining the structural stability of the mound tombs or exposing the human remains located in the tombs.

James Cutter Tomb: Southwest Single Mound Tomb Adjacent to the Tilting Section of the Brick Perimeter Wall.

The section of brick perimeter wall located at the rear of the James Cutter tomb at the southwest corner of the burying ground is twelve feet from the backside of the granite cap stone. Using the 11'- 6" dimension from the backside of the cap stone to parking lot side of the perimeter wall from the adjacent row of tombs as a standard, it would appear that the brick perimeter wall is not part of the structural wall of this tomb and can be safely removed and rebuilt without impacting the tomb. A probe completed from the top of the tomb adjacent to the brick wall confirmed that the brick wall is distinct from the structure of the tomb. If, during the removal of the brick wall, a small section of the interior of the tomb is exposed, this opening should be closed up with bricks and mortar.

Removal and rebuilding of this section of the wall however should be undertaken carefully as the number of marble tomb plaques embedded in the east facing section of the wall indicates that at one time there might have been additional mound tombs in the southwestern corner of the burying ground. Another concern is that while the row of 10 contiguous tombs gain stability by sharing side walls with adjacent tombs, as well as from the interlocking granite units that make up the front wall, the stability of the stand-alone tomb in the southwest corner depends on maintaining the soil cover on top of and along the sides of the tomb.

Two sets of tombs located at the northern end of the burying ground.

The tombs along the northern edge of the burying ground differ from those on the western perimeter. The northern tombs have brick sidewalls and brick vaults for roofs rather than the granite block sidewalls and granite slab roofs found on the west.

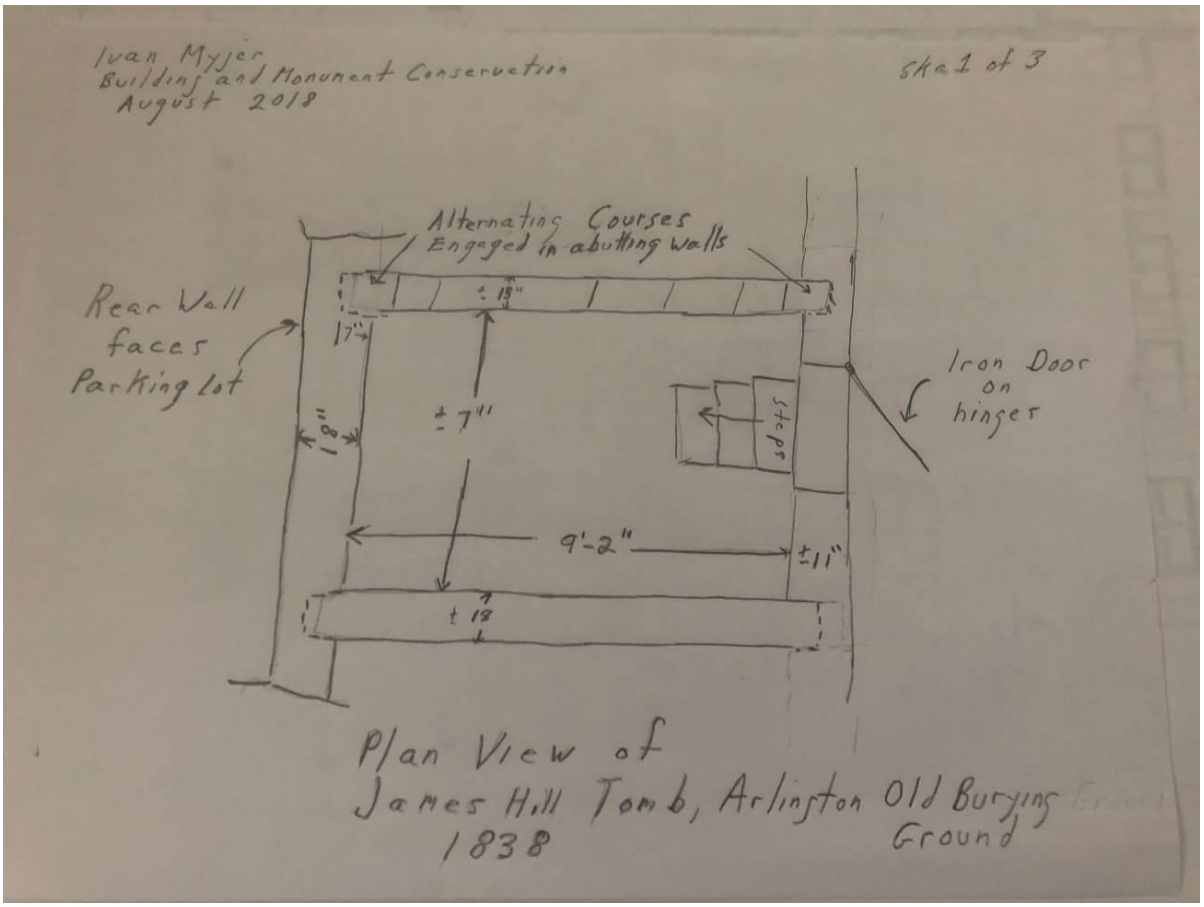
The northern tombs are much deeper than the western tombs. At the front of the tomb there is a small antechamber but then there is a second larger room located down a flight of stairs. The wall along the northern perimeter of the burying ground directly behind the two sets of tombs consist of long blocks of granite - two courses high. While the upper course is slightly pushed out of plane, the wall is stabile and does not require removal and rebuilding. In the future, if the outward lean becomes worse, it would probably be possible to remove and reset only the upper course of granite. This activity would not have an effect on the two sets of tombs located in the norther end of the burying ground. Care however should be taken in bringing heavy equipment into the northern edge perimeter of the burying ground because the full extent of the subterranean tomb is not visible from above ground.

Documentation of Tomb Construction and Relationship with Perimeter Walls

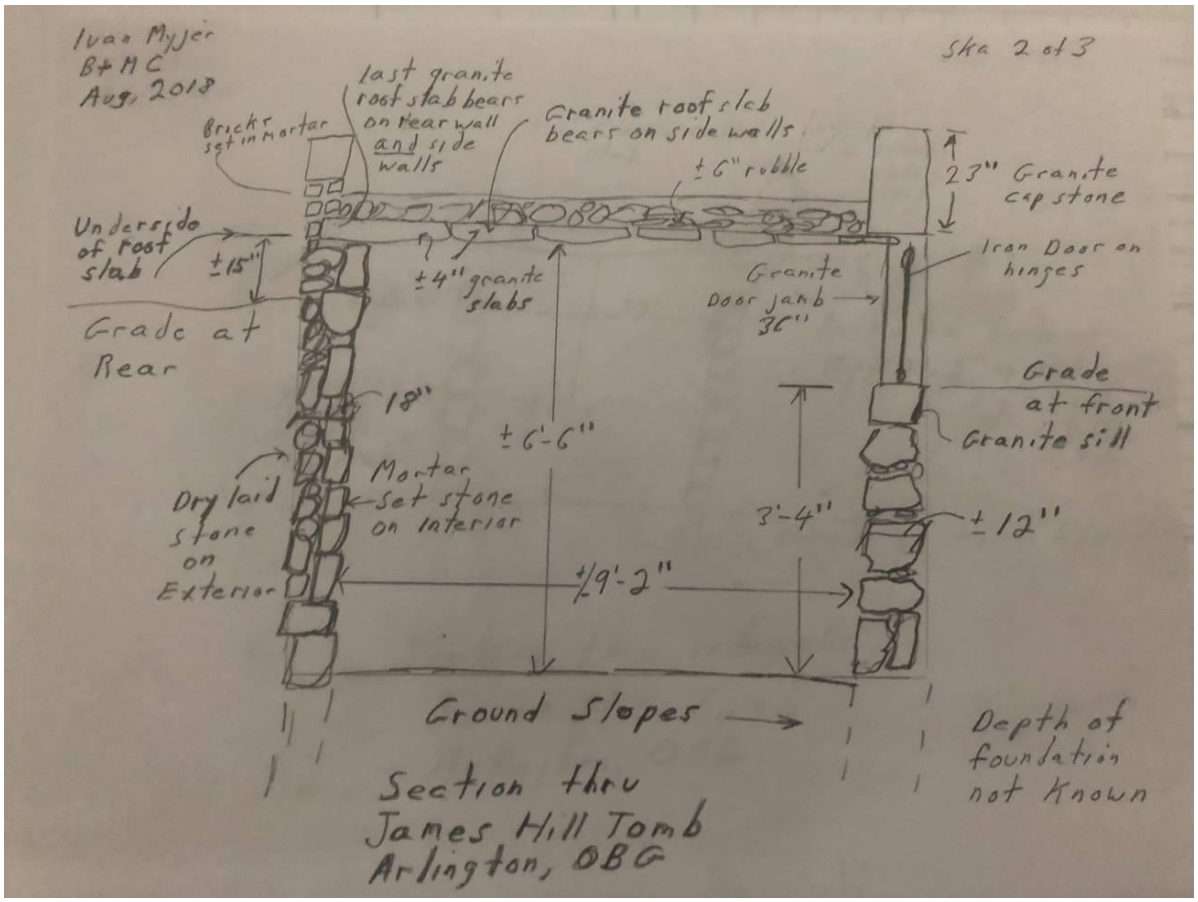
Interior view of Seth Frost Tomb with well-constructed rear wall that is in good condition. Note that granite roof slabs are supported by the side wall which is also in good condition. The last slab at the rear is wider and is supported by both the sidewalls and the rear wall. This detail is the same for all of the flat slab tombs. Ref SKA 2 below for dimensions and location of grade on the front and back of the tombs.

Exterior probe at the rear of the James Hill Tomb to verify the location of the underside of the slab. The underside of the granite slab closest to the perimeter wall is located about 15 inches above grade. Ref SKA 2 below. The location of the underside of the roof marks the top of the structural walls of the tomb. Ref first photograph of interior. As the perimeter wall is dissembled, the maximum portion of the structural wall that can be exposed is about 15 inches.

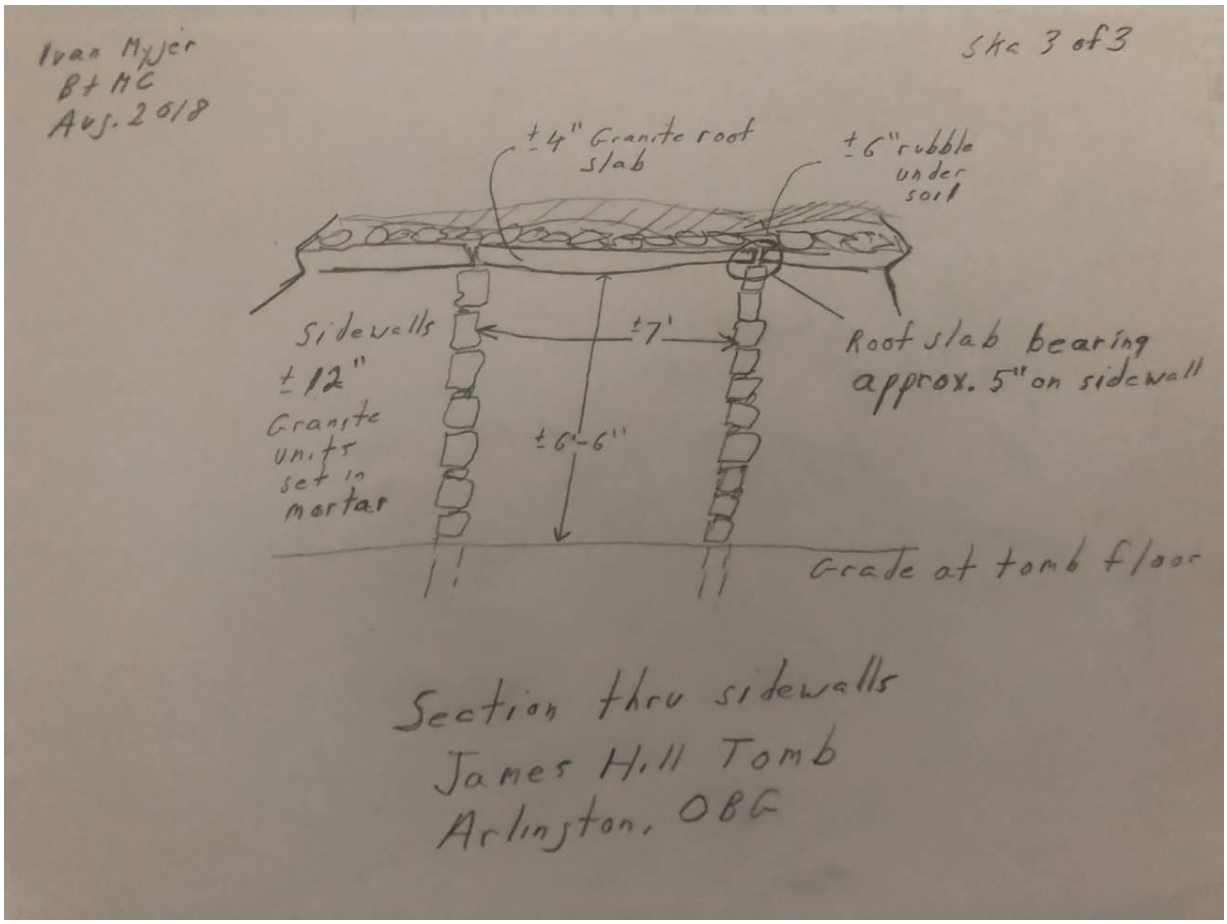
Interior of the James Hill tomb at the steps. Note the human remains and trash on the floor. The floor of the tomb in unfinished and all of the caskets have rotted away. The remains are scattered around the floor. Ref Ska 1 below for dimensions of the interior.



The sketch above shows that the structural walls of the tomb are engaged with each other to ensure stability. The photographs of the interior show that the structal walls were constructed of granite set in mortar. The photographs of the exterior show that the perimeter walls were mostly dry laid with the exception of the brickwork which is also set in mortar.



Ska 2 above shows that the perimeter wall and the structural walls of the tomb are joined. The structural walls of the tomb however were laid in mortar while the perimeter walls of the OBG were not. This distinction should make it very easy to determine where the perimeter wall ends and the structural walls begin during the disassembly of the perimeter walls. The 15-inch measurement shown above from the underside of the roof slab to the height of the soil on the rear wall defines the zone of the rear of the tombs that might be impacted by the disassembly and rebuilding of the west perimeter walls.



Ska 3 above shows that the sidewalls of the tombs are constructed from coursed granite set in mortar. The granite roof slabs bear on roughly half of the thickness of the sidewalls

Photograph of interior of brick vaulted tomb on the norther edge of the burying ground. The photograph shows the small granite roofed entry chamber in the foreground and the brick vaulted burial chamber in the background. The burial chambers of the four tombs at the northern edge of the burying ground are deeper than the single chamber on the western edge.

Recommended scope of work for each section of the west perimeter wall.

Section A: - Roughly 10 feet – extending south of entrance.

This section of wall was partially rebuilt and repointed within the last 10 years however, the coping stones for the rebuilt section are missing. The only work required in this section would be to replace the missing coping stones with new granite coping stones that match the existing. There are some large stones lying on the ground inboard of the wall but they are too narrow to serve as coping stones for this wall.

Section B- Roughly 40 feet extending from Section A to the juncture with the side wall of the first tomb. The work in Section B should be undertaken concurrently with the work in Section C on the sidewall of the first tomb.

- Powerwash wall to remove moss and other organic growths.
- Remove coping stones and retain for reuse.
- Remove loose wall stones and failed mortar directly under coping stones.
- Add matching stones to top of wall as required to create level bid for coping stones.
- Reset wall stones in mortar prior to resetting coping stones in their original locations.
- Remove loose and failing mortar on both sides of the wall and repoint joints with Type N mortar. Add small pieces of granite as required to wall to fill large voids and to shim existing wall units prior to repointing wall.
- Where possible, interweave stones from rebuilt wall in Section C into the inboard face of Section B.
- Reset coping stones in original location using a full mortar bed and then point vertical joints between units.

Section C- Sidewall of first tomb which is leaning and close to collapse. Roughly 12 feet long. The rebuilding of this section should be undertaken concurrently with the repointing of Section B. Where possible, the ends of the stones in Section C should be inserted into openings in Section B. This will reinforce both walls.

- Install barrier at top of tomb to keep soil and rubble on top of granite slab roof of tomb in place while this section of wall is rebuilt.

- Protect existing structural wall of tomb where it is exposed during the removal of the sidewall.
- Remove mortar from existing stones.
- Powerwash stones to remove moss, lichens etc
- Create new sub-grade footing for wall from crushed stone and gravel.
- Rebuild wall to match existing – reusing original stones and inserting new matching stones where needed. Use small shards of granite to shim larger stones in place,
- Set stones in mortar but deeply rake out mortar so that mortar does not come out to the faces of the stones.
- Reset existing coping stones in mortar bed in their original locations.

Section D - Roughly 35 feet from location where sidewall of first tomb meets wall to where the wall changes from large pieces of coursed granite to smaller pieces of granite rubble. Section D requires mostly just repointing but three granite coping stones at the south end of the section as well as the stones directly below them need to be removed and reset.

- Powerwash wall to remove moss and other organic growths.
- Remove and retain for re-installation the 3 displaced coping stones at the southern end of this section.
- Remove loose wall stones and failed mortar directly under coping stones.
- Add matching stones to top of wall as required to create level bid for coping stones.
- Reset wall stones in mortar prior to resetting coping stones in their original locations.
- Remove failed and cracked mortar along the entire length of this section and repoint joints using a Type S mortar with weather struck joints.

Section E – Roughly 20 feet from where the coping is displaced in Section D to the start of the section with the higher rear capstone and the introduction of brickwork into the wall. This section of the wall requires the same type of disassembly and rebuilding as Section C.

- Install barrier at top of tomb to keep soil and rubble on top of granite slab roof of tomb in place while this section of wall is rebuilt.
- Remove coping stones and retain for reinstallation.

- Take down existing wall and salvage all stones for reuse.
- Protect existing structural wall rear wall of tomb where it is exposed during the removal of the sidewall by shoring.
- In locations where there are gaps in the rear wall of the tomb, fill gaps with granite and mortar.
- Remove mortar from existing stones.
- Powerwash to remove moss, lichens etc
- Create new sub-grade footing for wall from crushed stone and gravel.
- Rebuild wall to match existing – reusing original stones and inserting new matching stones where needed. Use small shards of granite to shim larger stones in place,
- Set stones in mortar but deeply rake out mortar so that mortar does not come out to the faces of the stones.
- Reset existing coping stones in mortar bed in their original locations.

Section F – Roughly 60 feet from start of brick and stone mix to the beginning of the all brick wall. This is roughly in line with the south side of the last of the ten contiguous tombs. This entire section of wall has to be rebuilt. The difference between Section F and Section E is that Section F contains a mix of granite rubble and brickwork.

- Install barrier at top of tomb to keep soil and rubble on top of granite slab roof of tomb in place while this section of wall is rebuilt.
- Document the locations of brick coursing and obtain new, matching bricks.
- Remove coping stones and retain for reinstallation.
- Take down existing wall and salvage all stones for reuse but discard brickwork .
- Protect existing structural wall rear wall of tomb where it is exposed during the removal of the sidewall by shoring.
- In locations where there are gaps in the rear wall of the tomb, fill gaps with granite and mortar.
- Remove mortar from existing stones.
- Powerwash to remove moss, lichens etc
- Create new sub-grade footing for wall from crushed stone and gravel.

- Rebuild wall to match existing – reusing original stones and inserting new matching stones and bricks where needed. Use small shards of granite to shim larger stones in place. Create level surfaces for the placement of brick coursing.
- Brick coursing to be a minimum of two wythes thick but thicker where required.
- Set stones in mortar but deeply rake out mortar so that mortar does not come out to the faces of the stones.
- Reset existing coping stones in mortar bed in their original locations.

Section G – Roughly 50 feet from the start of the all brick construction to the end of the wall at the south side of the property. This entire section of wall has to be rebuilt on a new footing using new matching bricks. Care has to be taken to document the location and sizes of the marble tomb plaques and then construct niches in the rebuilt wall to receive the marble plaques.

- Install barrier at top of tomb to keep soil and rubble on top of granite slab roof of tomb in place while this section of wall is rebuilt.
- Document the brick bond pattern and obtain new, matching bricks as needed to rebuild the entire section.
- Remove coping stones and retain for reinstallation.
- Take down existing wall and salvage the marble plaques and coping stones for reuse - discard brickwork .
- Protect existing structural wall rear wall of tomb where it is exposed during the removal of the backwall. In locations where there are gaps in the rear wall of the tomb, fill gaps with granite and mortar.
- Provide adequate footings for the new perimeter wall.
- Rebuilding wall with matching bricks and joint sizes as well as brick bonding.
- Create niches of the existing marble tomb plaques on the interior face of the wall.
- Reset coping stones in full mortar bed and point joints between units.

June 7, 2018

Michelle de Tarnowsky
Ray Dunetz Landscape Architecture
179 Green Street
Boston, MA 02130

RE: - Limited Field Investigation – Old Burying Ground - Arlington, MA
P&S Project Number: 17175

Dear Michelle,

P&S personnel investigated areas at the Old Burying Ground on February 21, 2018, in order to assess the existing site topsoil conditions with regard to supporting turf grass and tree plantings. The purpose of the study was to evaluate the thickness and quality of site soils, evaluate the drainage conditions at the site, and provide recommendations for amendment and restoration of the lawn.

P&S excavated test holes dug across the cemetery, generally evenly distributed across the area. The test pits allowed assessment of the topsoil and of the shallow subsoils at discrete sampling locations. Test pits were excavated to approximately 8-20" deep. Topsoil samples were collected to evaluate the gradation, drainage characteristics and horticultural chemistry of the media. Topsoil depth was measured at each sampling location and an assessment of soil drainage and compaction level was made at each test pit.

P&S also reviewed the draft Tree Assessment and Recommendations report by Tree Specialists Inc., dated February 16, 2018 and the Ray Dunetz Landscape Architecture (RDLA) Preliminary Assessment Report. P&S also spoke with the director of the maintenance staff who coordinates mowing and cleanup of the burying ground.

Soil samples were brought to P&S' laboratory for classification. Composite topsoil samples were submitted to the University of Massachusetts Soil Testing Laboratory for sieve with hydrometer testing and full nutrient profile. Results of laboratory tests are attached.

The topsoil samples selected for analysis were composite samples collected from five areas of the burying ground. P&S collected approximate one cup samples from 8-10 sampling points across each area. The samples were placed in a 5 gallon bucket and thoroughly mixed in the field, creating a composite sample for each area. The composite samples were bagged and brought to P&S office for characterization

and packaging for shipment to the UMass Laboratory. The Burying Ground was divided into the subsampling areas by bisecting the area on approximate north south and east west axes, and an additional sample was collected from above the tomb chambers on the west side.

Field Observations and Laboratory Results

P&S understands that this site is proposed for improvement to increase the usability, safety and beauty of the area, and recommendations regarding amendment and restoration to the horticultural soils are required. We understand that portions of the area remain wet for extended time periods after rain storms and that the appearance and performance of the turf grass is generally poor. The soil profile observed in the cemetery consists of a variable thickness of topsoil, over variable fill soils, ranging from silty sand and gravel, rocks and boulders to B-horizon subsoils. The topsoil is generally fine-grained. The existing turf exhibits reasonably good root penetration but is spotty, with numerous areas of bare ground apparent, particularly beneath existing trees. A thick layer of root mass and thatch was observed at several areas, mainly in the southwest quadrant, up to 2" thick. The maintenance director stated that to his knowledge, no amendments or any work to the existing turf has ever been done beyond mowing. The thick thatch and root mass at the surface of the soil profile is a primary cause of the poor turf conditions observed.

Observations of the area topography indicates that the cemetery drains generally from west to east, toward Pleasant Street. However, the grading of the cemetery is undulating with numerous depressions, makeshift swales and low areas that accumulate water. Our investigation was conducted in mid-February; thus, the lawn and plantings were dormant. The study was conducted after a thawing period, but some areas of frost were encountered approximately five inches below ground surface.

Compaction Level

Compaction of the lawn areas was assessed with a Dickey-John soil compaction probe. The probe device is a manually operated probe with a tee-handle and a gauge that measures the relative amount of force that is required to advance the point of the probe. It has a 1/2" or 3/4" point and a range of 0-350 psi. This device allows quick assessment of the differences in compaction at multiple locations. Compaction levels between 200-300 psi are relatively adequate for root penetration and levels below 150 psi may be subject to differential settlement. The compaction level of the topsoil was moderate across the lawn areas, in the range of 175-250 psi. The northeastern part of the lawn was generally less compact than the other areas, but that could be attributable to high soil moisture conditions.

Soil Gradation

Topsoil

The topsoil observed on site ranged from 6 to 24 inches in thickness. Many of the test locations had two layers of topsoil that were slightly different in color, though the

texture of the materials were very similar. The lower layer of topsoil was light brown in color with a significant proportion of fine to coarse gravel. The upper 3-6- inches of topsoil was darker brown and with little gravel. Samples were collected from both layers of topsoil when present.

Laboratory testing of the topsoil indicates that it has a USDA Textural classification of sandy loam to loam. The loamy topsoil ranged from 44 to 54 percent silt plus clay with an average silt plus clay content of 49 percent. The clay fraction was in the range of 11 to 12 percent, and the gravel fraction was generally in the range of 10 to 16 percent. The organic content of the sandy loam topsoil ranged from 6.7 to 8.8 percent, with an average organic content of 7.6 percent. The organic content of the soil is at an adequate level for lawn and plantings. The texture of the topsoil is more fine-grained than typically specified for public spaces and is subject to poor drainage.

Subsoil
Excavation into the subsoil was limited as it is not the focus of this study. The shallow subsoil observed consisted of stony silty fine sand. Some test holes encountered larger stones and/or boulders below the topsoil.

Soil Chemistry
Laboratory testing of the topsoil indicates that the material is relatively consistent. The pH level of the soil was very low, ranging from 4.5 to 5.0. Calcium and magnesium levels were also low, indicating that little or no limestone has been applied as part of regular maintenance. The cation exchange capacity of the soils was in the range of 15 to 16, which is good. Nutrient and micronutrient levels were generally in the low to very low range, but phosphorus levels were elevated. Fertilizer applications should be with a high nitrogen and no/low phosphorus fertilizer. Iron, lead and aluminum levels were elevated in the samples, but not at levels that are considered phytotoxic.

Discussion

General
Successful turf and optimal growth depend on a number of factors; compaction levels, drainage conditions, planting media, nutrient status and maintenance. Poor drainage, resulting in excessive wetness, can result in anaerobic conditions and rapid deterioration of newly planted turf. Soil wetness is primarily related to ground water conditions, internal soil drainage, surface grading, organic matter content and the gradation of the planting medium.

Any one of the above factors can lead to poor turf conditions. To a limited degree one factor can compensate for another. Strong surface grading can reduce the effects of poor internal soil drainage and good internal soil drainage can reduce the effects of inadequate surface gradients. However, all of the factors must be appropriately addressed in order to create successful plantings.

Internal Soil Drainage

The capacity to move water into and through the soil and to prevent saturation of the growing media is essential. The amount of water infiltration is a function of the nature of the soil surface, the gradation of the topsoil, and the surface gradient. For most areas with healthy turf, essentially all rainfall for low to moderate rates of rain will infiltrate the ground. Approximately one half of rainfall for intense rain events, such as thunderstorms, will infiltrate the ground. Depending on the dryness of the soil at the beginning of a rainfall event, one to two inches of infiltration can result in saturation of the topsoil layer, unless the water can move freely into the subsoil and away from the area.

Planting Medium Gradation

The grain size distribution of a growing medium affects internal drainage, water holding capacity, compactability, and nutrient retention. The gradation of the planting medium for high-use lawn areas must contain adequate silt and clay-sized particles and adequate organic material to provide moisture retention and nutrients for turf. However, the amount of silt and clay must be limited. Planting medium, which is too fine-grained affects conditions in four ways. First, water moves slowly through the soil to the subgrade. Second, the soil retains more water, resulting in damp conditions for longer periods of time. Third, the soil is relatively compactable, and this further reduces porosity and water movement. And fourth, the strength of the soil and turf to support vehicles and/or foot traffic is reduced. Optimum grain size distributions balance these factors for either irrigated or non-irrigated conditions.

Field observations and laboratory results indicate the soil across the site is relatively fine grained and subject to slow infiltration capacity. However, given the soil texture and relatively high organic matter content, the soil also has good moisture retention, which reduces the need for irrigation.

Findings, Conclusions and Recommendations

The purpose of the study was to evaluate the topsoil and subsurface drainage conditions at the Old Burying Ground and to develop recommendations for restoration and improvement to the turf grass. P&S understands that the cemetery is proposed for improvements, including tree work, restoration of retaining walls, improvement to headstones and tombs, and other improvements.

The findings of our investigation are that the existing topsoil is too fine grained than typically recommended for parkland, resulting in excess wetness after precipitation events. Topsoil for use in park areas must be well-drained, but also provide adequate organic matter and nutrient holding capacity to support quality turf. However, given the existing non-irrigated conditions, and that the cemetery is only subject to passive use, excess wetness caused by poorly drained soils does not appear to be a primary issue at the project site. In fact, overly dry soil conditions appear to be contributing to

failure of turf at the eastern side of the project site. The primary issues for the poor turf conditions appear to be associated with lack of maintenance. pH levels are very low, which reduces nutrient uptake and availability of nutrients. Bare ground areas have not been re-seeded and soil fertility is low. Thatch has reduced the ability for root penetration and the grades allow for ponding of water. In addition the lawn appears to be in shade for many hours of the day.

Our initial recommendation for the topsoil at the cemetery is a complete restoration of the turf areas, including installation of an irrigation system. However, we understand that the area is sensitive, and work must be conducted with minimal disturbance to historic gravesites. Therefore, a complete soil restoration is not feasible.

Preliminary Reconstruction Recommendations

Our analysis of conditions at the Old Burying Ground Field Areas indicates that major ongoing problems will continue indefinitely unless significant remedial actions are taken. The existing topsoil is too fine grained and poorly drained. Thatch and fine feeder roots from the trees have also created an impenetrable barrier to new turf rooting in many areas. Also, excessive shade from the existing trees is limiting the growth of turf. In addition, the surface grades are uneven, allowing water to pond at low spots and creating an unkempt appearance.

The soil testing indicates that most nutrient and micronutrient levels are in the low to very low range. Exacerbating nutrient availability is that the pH level of the soil ranges from 4.5 to 5.0, which is very acidic, limiting nutrient uptake.

Our typical recommendations for restoration would include stripping and stockpiling topsoil, improvement to subgrade drainage conditions, and amendment and replacement of improved topsoil. This solution is not feasible in this situation due to the potential of disturbing gravesites, and the need to preserve the healthy trees at the site. Therefore, an alternate solution is presented to allow for reestablishment of turf with as little disturbance to the soils and gravesites as possible.

To reestablish the turf at the project site we recommend correcting surface grades by filling the low areas, amending the soils and re-seeding the lawn areas. In order for the new seed to properly become established, it is essential to create a proper seed bed. Small walk behind cultivators are available that will allow cultivation with minimal disturbance to existing gravesites. Headstones and other sensitive areas may need to be protected for this operation, but the machinery is relatively lightweight and compact. One such machine is a Dingo, manufactured by Toro, but there are other manufacturers of this type equipment. Photos of the recommended equipment are provided below.

A quality dependable landscape contractor should be selected for the restoration of the lawn areas. We recommend interviewing potential contractors and selecting the most qualified candidate with the most appropriate equipment available. We also

recommend creating a work plan to clearly define the scope of work and any protective measures that are necessary to preserve historical structures and protect sensitive areas. The restoration work should be observed and documented by a landscape professional to ensure the work is conducted per Plans and Specifications, and that protective measures are maintained.

Examples of small soil cultivators recommended for use.

Soil Cultivator (23102)

Power Box Rake (22426)

Procedures for Establishment of New Turf

- Fill depressions with new lawn soil to allow for uniform grades that do not capture water.
- Apply pelletized limestone at 90 lbs./1,000sf. Water in thoroughly. Additional applications of limestone over time may be required
- Top dress soil up to ½" with uniformly graded sand.
- Till/cultivate soil to incorporate amendments to 2" deep, breaking up the thatch/root mass layer.
- Remove debris by raking.
- Use manual tools to blend new or re-worked soils around headstones and sensitive areas to create a smooth even surface.
- Hydroseed or slice seed entire lawn area with a shade and drought tolerant seed mix. Fescues are typically the best cultivar for this application.
- Apply temporary irrigation for the turf establishment period, typically 4-6 weeks.

All tree work and other restoration tasks should be completed prior to establishment of new turf. The new turf should be protected during the establishment period, and the new work should be monitored daily to allow for irrigation adjustments, control invasive weeds and maintain protective measures.

For planting of new trees, we understand that excavation into the existing soils must be limited. Therefore, small landscape stock should be selected, and the excavation

of soils for planting should be limited. We recommend adding approximately 25% of compost into the plant backfill soil to raise pH, provide for additional nutrients and beneficial soil microbes and also boost organic matter.

To be clear, these recommendations are based on our limited field investigation and laboratory testing. It is critical to provide construction observations and documentation during the restoration process to ensure the work is conducted according to the contract documents. Due to the very low pH level of the soil, multiple applications of pelletized limestone may be required to raise the pH level of the soil to a recommended range of 6.3-6.5. We also recommend increasing the maintenance level for the area to include frequent soil testing, fertilizer applications, limestone applications, core aeration and other maintenance tasks.

If requested, P&S will provide Specifications and construction administration services for this project under a separate Scope of Work once the final plan for lawn restoration is decided. Thank you for engaging us on this project.

Sincerely

Michael Agonis, Environmental Scientist
Project Manager

Soil and Plant Nutrient Testing Laboratory
203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: OBG NE

Order Number: 35176
Lab Number: S180227-131
Area Sampled: 0.2 acres
Received: 2/27/2018
Reported: 3/7/2018

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	4.5	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	16.8	4-14
Potassium (K)	54	100-160
Calcium (Ca)	149	1000-1500
Magnesium (Mg)	21	50-120
Sulfur (S)	19.7	>10
Micronutrients *		
Boron (B)	0.0	0.1-0.5
Manganese (Mn)	1.8	1.1-6.3
Zinc (Zn)	4.2	1.0-7.6
Copper (Cu)	1.2	0.3-0.6
Iron (Fe)	77.4	2.7-9.4
Aluminum (Al)	444	<75
Lead (Pb)	45.1	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	16.8	
Exch. Acidity, meq/100g	15.7	
Base Saturation, %		
Calcium Base Saturation	4	50-80
Magnesium Base Saturation	1	10-30
Potassium Base Saturation	1	2.0-7.0
Scoop Density, g/cc	0.88	
Optional tests		
Soil Organic Matter (LOI), %	8.8	
Nitrate-N (NO3-N), ppm	3	

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

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Recommendations for New Lawn Construction

Limestone (Target pH of 6.5)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 1000 sq ft		
325	2 - 4	0	3

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Incorporate limestone thoroughly into the top 6 inches of soil.
-Your magnesium level is low. Dolomitic limestone is recommended.
-Soil test phosphorus is above optimum. No additional P2O5 is required.
-Many fertilizer sources and rates may be combined to provide acceptable turfgrass fertilty.
-Avoid over-fertilization. In addition to threatening water quality, excessive nutrient applications can compromise plant health and contribute to insect and disease problems. For details, see Reference "Over-Fertilization: Its Causes, Effects and Remediation" (listed below).
-For best results, split the N, P2O5, and K2O recommendations above into three to four applications over the course of the growing season at six to eight week intervals, beginning in mid- to late-April.

References:

Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
Home Lawn and Garden Information	http://ag.umass.edu/resources/home-lawn-garden
Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds
Corrective Measures and Management of Over-Fertilized Soils	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/corrective-measures-management-of-over-fertilized

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Recommendations for Deciduous Trees, Shrubs & Vines-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
25	.1 - .2	0	0.25

Comments:

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-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.
-Soil test values for phosphorus are above optimum. Do not add additional phosphorus at this time
-Avoid over-fertilization. In addition to threatening water quality, excessive nutrient applications can compromise plant health and contribute to insect and disease problems. For details, see Reference "Over-Fertilization: Its Causes, Effects and Remediation" (listed below).

References:

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Corrective Measures and Management of Over-Fertilized Soils	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/corrective-measures-management-of-over-fertilized

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Recommendations for Needleleaf Trees & Shrubs-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
25	.1 - .2	0	0.1

Comments:

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-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.
-Soil test values for phosphorus are above optimum. Do not add additional phosphorus at this time
-Avoid over-fertilization. In addition to threatening water quality, excessive nutrient applications can compromise plant health and contribute to insect and disease problems. For details, see Reference "Over-Fertilization: Its Causes, Effects and Remediation" (listed below).

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Corrective Measures and Management of Over-Fertilized Soils	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/corrective-measures-management-of-over-fertilized

General References:

Interpreting Your Soil Test Results	http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results
For current information and order forms, please visit	http://soiltest.umass.edu/
UMass Extension Nutrient Management	http://ag.umass.edu/agriculture-resources/nutrient-management

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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:
Sample ID: OBG NE

Prepared For:
Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Order Number: 35303
Lab Number: X180306-107
Received: 3/6/2018
Reported: 3/12/2018

USDA Size Fraction

Main Fractions	Size (mm)	Percent
Sand	0.05-2.0	50.4
Silt	0.002-0.05	38.4
Clay	<0.002	11.2

Sand Fractions	Size (mm)	Percent
Very Coarse	1.0-2.0	6.2
Coarse	0.5-1.0	12.5
Medium	0.25-0.5	13.6
Fine	0.10-0.25	10.9
Very Fine	0.05-0.10	7.2

Silt Fractions	Size (mm)	Percent
Coarse	0.02-0.05	24.4
Medium	0.005-0.02	12.2
Fine	0.002-0.005	1.8

Percent of Whole Sample Passing

Size (mm)	Sieve #	Whole Sample % of Sample Passing	Finer Than 2mm % of Sample Passing
2.00	#10	89.1	100.0
1.00	#18	83.6	93.8
0.50	#35	72.5	81.3
0.25	#60	60.4	67.7
0.10	#140	50.7	56.8
0.053	#270	44.2	49.6
0.02	20 um	22.5	25.2
0.005	5 um	11.6	13.0
0.002	2 um	10.0	11.2

USDA Textural Class: loam

Gravel Content: (%) 10.9

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Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: OBG NW

Order Number: 35176
Lab Number: S180227-129
Area Sampled: 0.2 acres
Received: 2/27/2018
Reported: 3/7/2018

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	4.6	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	7.2	4-14
Potassium (K)	43	100-160
Calcium (Ca)	248	1000-1500
Magnesium (Mg)	16	50-120
Sulfur (S)	14.2	>10
Micronutrients *		
Boron (B)	0.0	0.1-0.5
Manganese (Mn)	1.0	1.1-6.3
Zinc (Zn)	1.8	1.0-7.6
Copper (Cu)	0.9	0.3-0.6
Iron (Fe)	62.3	2.7-9.4
Aluminum (Al)	382	<75
Lead (Pb)	33.2	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	15.0	
Exch. Acidity, meq/100g	13.5	
Base Saturation, %		
Calcium Base Saturation	8	50-80
Magnesium Base Saturation	1	10-30
Potassium Base Saturation	1	2.0-7.0
Scoop Density, g/cc	1.04	
Optional tests		
Soil Organic Matter (LOI), %	6.8	
Nitrate-N (NO3-N), ppm	2	

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

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Recommendations for New Lawn Construction

Limestone (Target pH of 6.5)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 1000 sq ft		
275	2 - 4	0.5	3

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Incorporate limestone thoroughly into the top 6 inches of soil.
-Your magnesium level is low. Dolomitic limestone is recommended.
-Many fertilizer sources and rates may be combined to provide acceptable turfgrass fertilty.
-For best results, split the N, P2O5, and K2O recommendations above into three to four applications over the course of the growing season at six to eight week intervals, beginning in mid- to late-April.

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Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
Home Lawn and Garden Information	http://ag.umass.edu/resources/home-lawn-garden
Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds

Recommendations for Deciduous Trees, Shrubs & Vines-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0.1	0.25

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.

References:

Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
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Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds

Soil and Plant Nutrient Testing Laboratory
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Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Recommendations for Needleleaf Trees & Shrubs-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0.05	0.1

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.

References:

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Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds

General References:

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Phone: (413) 545-2311
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website: soiltest.umass.edu

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:
Sample ID: OBG NW

Prepared For:
Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Order Number: 35303
Lab Number: X180306-106
Received: 3/6/2018
Reported: 3/12/2018

USDA Size Fraction

Main Fractions	Size (mm)	Percent
Sand	0.05-2.0	51.9
Silt	0.002-0.05	35.6
Clay	<0.002	12.5

Sand Fractions	Size (mm)	Percent
Very Coarse	1.0-2.0	5.3
Coarse	0.5-1.0	12.3
Medium	0.25-0.5	13.9
Fine	0.10-0.25	12.0
Very Fine	0.05-0.10	8.4

Silt Fractions	Size (mm)	Percent
Coarse	0.02-0.05	20.6
Medium	0.005-0.02	12.2
Fine	0.002-0.005	2.8

Percent of Whole Sample Passing

Size (mm)	Sieve #	Whole Sample % of Sample Passing	Finer Than 2mm % of Sample Passing
2.00	#10	84.5	100.0
1.00	#18	80.0	94.7
0.50	#35	69.6	82.4
0.25	#60	57.9	68.5
0.10	#140	47.8	56.5
0.053	#270	40.7	48.1
0.02	20 um	23.2	27.5
0.005	5 um	12.9	15.3
0.002	2 um	10.6	12.5

USDA Textural Class: loam

Gravel Content: (%) 15.5

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Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: OBG SE

Order Number: 35176
Lab Number: S180227-132
Area Sampled: 0.2 acres
Received: 2/27/2018
Reported: 3/7/2018

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	4.6	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	13.6	4-14
Potassium (K)	51	100-160
Calcium (Ca)	111	1000-1500
Magnesium (Mg)	20	50-120
Sulfur (S)	12.0	>10
Micronutrients *		
Boron (B)	0.0	0.1-0.5
Manganese (Mn)	2.3	1.1-6.3
Zinc (Zn)	2.1	1.0-7.6
Copper (Cu)	1.2	0.3-0.6
Iron (Fe)	90.9	2.7-9.4
Aluminum (Al)	320	<75
Lead (Pb)	41.8	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	14.8	
Exch. Acidity, meq/100g	13.9	
Base Saturation, %		
Calcium Base Saturation	4	50-80
Magnesium Base Saturation	1	10-30
Potassium Base Saturation	1	2.0-7.0
Scoop Density, g/cc	0.99	
Optional tests		
Soil Organic Matter (LOI), %	6.7	
Nitrate-N (NO3-N), ppm	1	

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

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website: soiltest.umass.edu

Recommendations for New Lawn Construction

Limestone (Target pH of 6.5)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 1000 sq ft		
275	2 - 4	0.5	3

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Incorporate limestone thoroughly into the top 6 inches of soil.
-Your magnesium level is low. Dolomitic limestone is recommended.
-Many fertilizer sources and rates may be combined to provide acceptable turfgrass fertilty.
-For best results, split the N, P2O5, and K2O recommendations above into three to four applications over the course of the growing season at six to eight week intervals, beginning in mid- to late-April.

References:

Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
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Recommendations for Deciduous Trees, Shrubs & Vines-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0	0.25

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.

References:

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Recommendations for Needleleaf Trees & Shrubs-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0	0.1

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
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References:

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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:
Sample ID: OBG South

Prepared For:
Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Order Number: 35303
Lab Number: X180306-108
Received: 3/6/2018
Reported: 3/12/2018

USDA Size Fraction

Main Fractions	Size (mm)	Percent
Sand	0.05-2.0	55.7
Silt	0.002-0.05	32.6
Clay	<0.002	11.7

Sand Fractions	Size (mm)	Percent
Very Coarse	1.0-2.0	7.7
Coarse	0.5-1.0	13.5
Medium	0.25-0.5	13.8
Fine	0.10-0.25	13.1
Very Fine	0.05-0.10	7.6

Silt Fractions	Size (mm)	Percent
Coarse	0.02-0.05	18.6
Medium	0.005-0.02	13.1
Fine	0.002-0.005	0.9

Percent of Whole Sample Passing

Size (mm)	Sieve #	Whole Sample % of Sample Passing	Finer Than 2mm % of Sample Passing
2.00	#10	88.2	100.0
1.00	#18	81.4	92.3
0.50	#35	69.5	78.8
0.25	#60	57.4	65.0
0.10	#140	45.8	51.9
0.053	#270	39.1	44.3
0.02	20 um	22.7	25.7
0.005	5 um	11.1	12.6
0.002	2 um	10.3	11.7

USDA Textural Class: sandy loam

Gravel Content: (%) 11.8

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Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: OBG SW

Order Number: 35176
Lab Number: S180227-130
Area Sampled: 0.2 acres
Received: 2/27/2018
Reported: 3/7/2018

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	4.6	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	14.2	4-14
Potassium (K)	82	100-160
Calcium (Ca)	108	1000-1500
Magnesium (Mg)	23	50-120
Sulfur (S)	23.6	>10
Micronutrients *		
Boron (B)	0.0	0.1-0.5
Manganese (Mn)	1.9	1.1-6.3
Zinc (Zn)	2.0	1.0-7.6
Copper (Cu)	1.3	0.3-0.6
Iron (Fe)	62.4	2.7-9.4
Aluminum (Al)	543	<75
Lead (Pb)	50.3	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	16.4	
Exch. Acidity, meq/100g	15.5	
Base Saturation, %		
Calcium Base Saturation	3	50-80
Magnesium Base Saturation	1	10-30
Potassium Base Saturation	1	2.0-7.0
Scoop Density, g/cc	0.73	
Optional tests		
Soil Organic Matter (LOI), %	8.1	
Nitrate-N (NO3-N), ppm	1	

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

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Recommendations for New Lawn Construction

Limestone (Target pH of 6.5)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 1000 sq ft		
325	2 - 4	0	2

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Incorporate limestone thoroughly into the top 6 inches of soil.
-Your magnesium level is low. Dolomitic limestone is recommended.
-Soil test phosphorus is above optimum. No additional P2O5 is required.
-Many fertilizer sources and rates may be combined to provide acceptable turfgrass fertilty.
-For best results, split the N, P2O5, and K2O recommendations above into three to four applications over the course of the growing season at six to eight week intervals, beginning in mid- to late-April.

References:

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Recommendations for Deciduous Trees, Shrubs & Vines-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
25	.1 - .2	0	0.25

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.
-Soil test values for phosphorus are above optimum. Do not add additional phosphorus at this time

References:

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website: soiltest.umass.edu

Recommendations for Needleleaf Trees & Shrubs-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
25	.1 - .2	0	0.1

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.
-Soil test values for phosphorus are above optimum. Do not add additional phosphorus at this time

References:

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Soil Test Report

Prepared For:

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867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: OBG TOMB

Order Number: 35176
Lab Number: S180227-133
Area Sampled: 0.1 acres
Received: 2/27/2018
Reported: 3/7/2018

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	5.0	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	4.3	4-14
Potassium (K)	55	100-160
Calcium (Ca)	327	1000-1500
Magnesium (Mg)	37	50-120
Sulfur (S)	11.3	>10
Micronutrients *		
Boron (B)	0.0	0.1-0.5
Manganese (Mn)	5.6	1.1-6.3
Zinc (Zn)	5.4	1.0-7.6
Copper (Cu)	0.9	0.3-0.6
Iron (Fe)	53.3	2.7-9.4
Aluminum (Al)	382	<75
Lead (Pb)	54.2	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	16.0	
Exch. Acidity, meq/100g	13.9	
Base Saturation, %		
Calcium Base Saturation	10	50-80
Magnesium Base Saturation	2	10-30
Potassium Base Saturation	1	2.0-7.0
Scoop Density, g/cc	0.97	
Optional tests		
Soil Organic Matter (LOI), %	7.5	
Nitrate-N (NO3-N), ppm	4	

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

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Recommendations for New Lawn Construction

Limestone (Target pH of 6.5)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 1000 sq ft		
275	2 - 4	1	3

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Incorporate limestone thoroughly into the top 6 inches of soil.
-Your magnesium level is low. Dolomitic limestone is recommended.
-Many fertilizer sources and rates may be combined to provide acceptable turfgrass fertilty.
-For best results, split the N, P2O5, and K2O recommendations above into three to four applications over the course of the growing season at six to eight week intervals, beginning in mid- to late-April.

References:

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Recommendations for Deciduous Trees, Shrubs & Vines-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0.1	0.25

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.

References:

Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
Home Lawn and Garden Information	http://ag.umass.edu/resources/home-lawn-garden
Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds

Soil and Plant Nutrient Testing Laboratory
203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Recommendations for Needleleaf Trees & Shrubs-Maintenance

Limestone (Target pH of 6.0)	Nitrogen, N	Phosphorus, P2O5	Potassium, K2O
	lbs / 100 sq ft		
22.5	.1 - .2	0.05	0.1

Comments:

-The lead level in this soil is elevated. It is recommended that soils with elevated levels of extractable lead (greater than 22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals. Ordering information can be found on our website here: https://soiltest.umass.edu/ordering-information.
-For instructions on converting nutrient recommendations to fertilizer applications in home gardens, lawns and landscapes, see Reference "Step-by-Step Fertilizer Guide for Home Grounds and Gardening" (listed below).
-Do not topdress with more than 5 lb limestone per 100 sq ft at one time. Split the above application between early spring and mid-autumn.

References:

Soil Lead: Testing, Interpretation & Recommendations	http://soiltest.umass.edu/fact-sheets/soil-lead-testing-interpretation-recommendations-0
Home Lawn and Garden Information	http://ag.umass.edu/resources/home-lawn-garden
Step-by-Step Fertilizer Guide for Home Grounds and Gardening	http://ag.umass.edu/soil-plant-nutrient-testing-laboratory/fact-sheets/step-by-step-fertilizer-guide-for-home-grounds

General References:

Interpreting Your Soil Test Results	http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results
For current information and order forms, please visit	http://soiltest.umass.edu/
UMass Extension Nutrient Management	http://ag.umass.edu/agriculture-resources/nutrient-management

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Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:
Sample ID: OBG Tomb

Prepared For:
Mike Agonis
Pine & Swallow Environmental
867 Boston Rd
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Order Number: 35303
Lab Number: X180306-109
Received: 3/6/2018
Reported: 3/12/2018

USDA Size Fraction

Main Fractions	Size (mm)	Percent
Sand	0.05-2.0	45.7
Silt	0.002-0.05	41.6
Clay	<0.002	12.7

Sand Fractions	Size (mm)	Percent
Very Coarse	1.0-2.0	4.9
Coarse	0.5-1.0	8.9
Medium	0.25-0.5	14.1
Fine	0.10-0.25	11.1
Very Fine	0.05-0.10	6.7

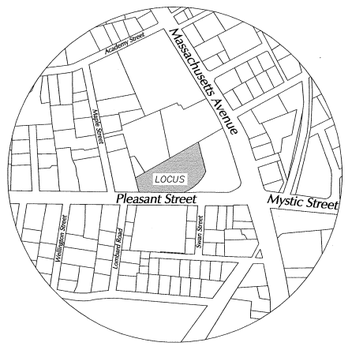
Silt Fractions	Size (mm)	Percent
Coarse	0.02-0.05	22.7
Medium	0.005-0.02	16.0
Fine	0.002-0.005	2.9

Percent of Whole Sample Passing

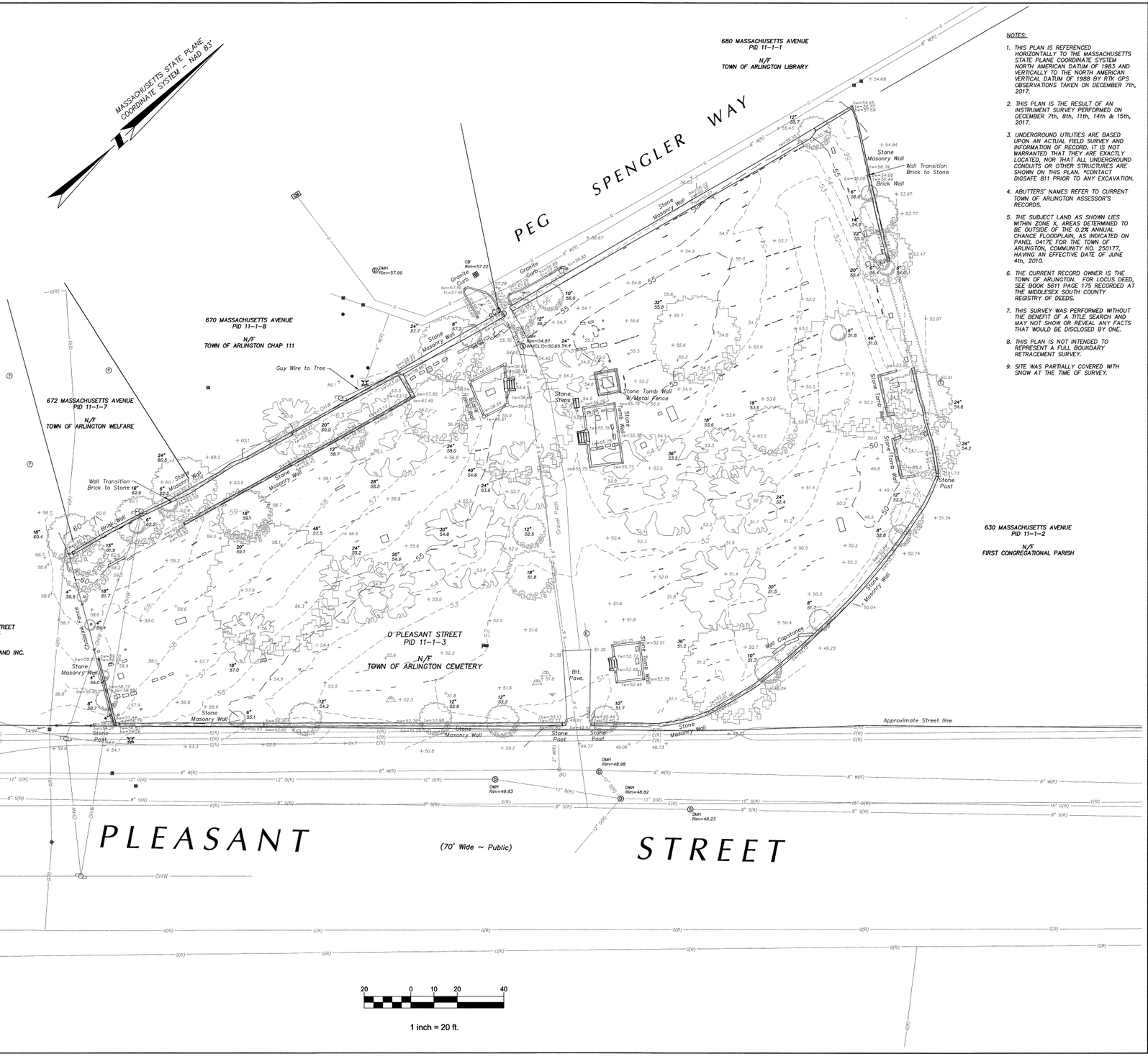
Size (mm)	Sieve #	Whole Sample % of Sample Passing	Finer Than 2mm % of Sample Passing
2.00	#10	83.6	100.0
1.00	#18	79.5	95.1
0.50	#35	72.0	86.2
0.25	#60	60.3	72.1
0.10	#140	51.0	61.0
0.053	#270	45.3	54.3
0.02	20 um	26.4	31.6
0.005	5 um	13.0	15.5
0.002	2 um	10.6	12.7

USDA Textural Class: loam

Gravel Content: (%) 16.4



VICINITY MAP
NTS



LEGEND

- CATCHBASIN
- DRAIN MANHOLE
- SEWER MANHOLE
- CLEAN OUT
- HYDRANT
- WATER GATE
- WATER SERVICE
- GAS METER
- GAS GATE
- GAS SERVICE
- ELECTRIC MANHOLE
- UTILITY POLE
- UNKNOWN MANHOLE
- SIGN
- BOLLARD
- POST
- GUY WIRE
- DECIDUOUS TREE
- CONIFEROUS TREE
- FLAGPOLE
- D — DRAIN LINE
- S — SEWER LINE
- W — WATER LINE
- G — GAS LINE
- E — ELECTRIC LINE
- OHW — OVERHEAD WIRE
- 60 — INDEX CONTOUR
- 59 — INTERMEDIATE CONTOUR
- +58.7 — SPOT GRADE
- tc= — TOP OF CURB ELEVATION
- bc= — BOTTOM OF CURB ELEVATION
- tw= — TOP OF WALL ELEVATION
- bw= — BOTTOM OF WALL ELEVATION
- ts= — TOP OF STEPS ELEVATION
- bs= — BOTTOM OF STEPS ELEVATION AT GRADE
- n/a — INVERT NOT AVAILABLE
- EOP — EDGE OF PAVEMENT
- EOG — EDGE OF GRAVEL
- EOS — EDGE OF STONE
- EOC — EDGE OF CONCRETE
- HEDGELINE
- (R) — RECORD LOCATION
- STUMP
- CLT — CENTERLINE TRENCH

NOTES:

1. THIS PLAN IS REFERENCED HORIZONTALLY TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NORTH AMERICAN DATUM OF 1983 AND VERTICALLY TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 BY RTK GPS OBSERVATIONS TAKEN ON DECEMBER 7th, 2017.
2. THIS PLAN IS THE RESULT OF AN INSTRUMENT SURVEY PERFORMED ON DECEMBER 7th, 8th, 11th, 14th & 15th, 2017.
3. UNDERGROUND UTILITIES ARE BASED UPON AN ACTUAL FIELD SURVEY AND INFORMATION OF RECORD. IT IS NOT WARRANTED THAT THEY ARE EXACTLY LOCATED, NOR THAT ALL UNDERGROUND CONDUITS OR OTHER STRUCTURES ARE SHOWN ON THIS PLAN. *CONTACT DIGSAFE 811 PRIOR TO ANY EXCAVATION.
4. ABUTTERS' NAMES REFER TO CURRENT TOWN OF ARLINGTON ASSESSOR'S RECORDS.
5. THE SUBJECT LAND AS SHOWN LIES WITHIN ZONE X, AREAS DETERMINED TO BE OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN, AS INDICATED ON PANEL 0417E FOR THE TOWN OF ARLINGTON, COMMUNITY NO. 250177, HAVING AN EFFECTIVE DATE OF JUNE 4th, 2010.
6. THE CURRENT RECORD OWNER IS THE TOWN OF ARLINGTON. FOR LOCUS DEED, SEE BOOK 5611 PAGE 175 RECORDED AT THE MIDDLESEX SOUTH COUNTY REGISTRY OF DEEDS.
7. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE SEARCH AND MAY NOT SHOW OR REVEAL ANY FACTS THAT WOULD BE DISCLOSED BY ONE.
8. THIS PLAN IS NOT INTENDED TO REPRESENT A FULL BOUNDARY RETRACEMENT SURVEY.
9. SITE WAS PARTIALLY COVERED WITH SNOW AT THE TIME OF SURVEY.

P:\PROJECTS\2017\17181.01 OLD BURYING GROUND - ARLINGTON (SURVEY)\DWG\17181 OLD BURYING GROUND WS.DWG

samiotes

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Civil Engineers + Land Surveyors

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Old Burying Ground
Pleasant Road
Arlington, MA

SEAL

COMMONWEALTH OF MASSACHUSETTS
JAMES P. HORGAN
No. 50302
PROFESSIONAL LAND SURVEYOR
09-26-18

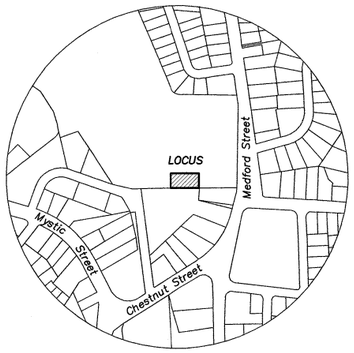
JAMES P. HORGAN - P.L.S. No. 50302
REGISTERED PROFESSIONAL
LAND SURVEYOR FOR
SAMIOTES CONSULTANTS, INC.

REVISION

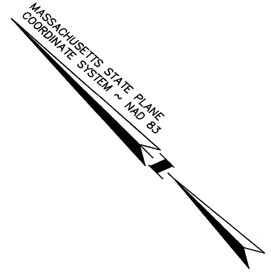
TOPOGRAPHIC PLAN OF LAND

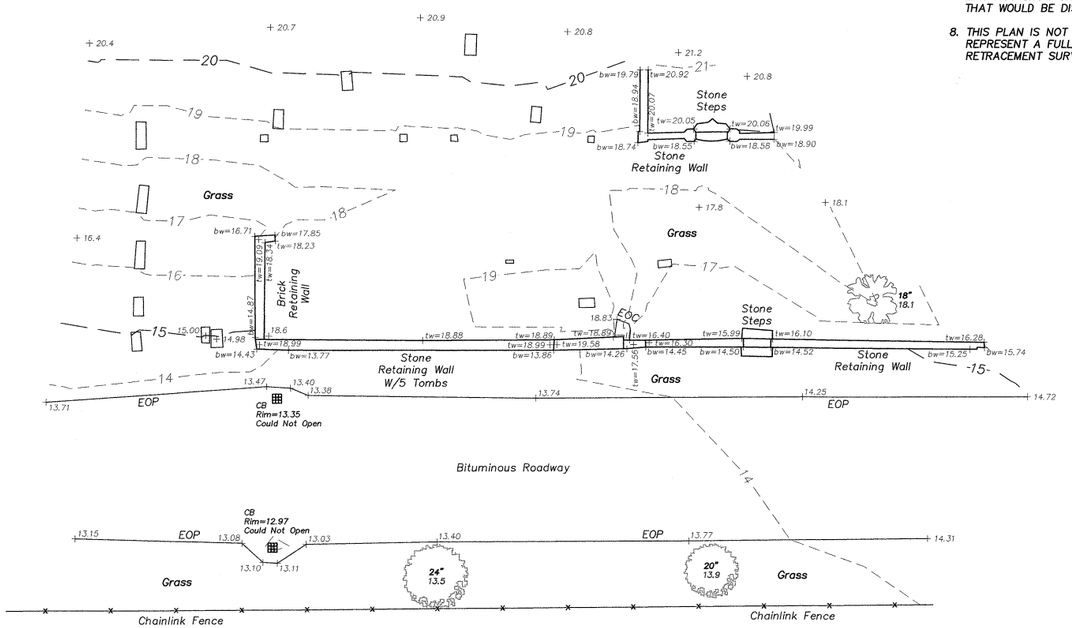
JOB # 17181.01	T1.1
DATE: 03.14.18	
SCALE: 1"=20'	
DRAWN BY: CY	
APPROVED BY: JPH	SHEET 1 OF 1

FILE: 17181 OLD BURYING GROUND WS.DWG



VICINITY MAP
NOT TO SCALE





NOTES:

1. THIS PLAN IS REFERENCED HORIZONTALLY TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NORTH AMERICAN DATUM OF 1983 AND VERTICALLY TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 BY RTK GPS OBSERVATIONS TAKEN ON DECEMBER 8, 2017.
2. THIS PLAN IS THE RESULT OF AN INSTRUMENT SURVEY PERFORMED ON DECEMBER 8, 2017.
3. UNDERGROUND UTILITIES ARE BASED UPON AN ACTUAL FIELD SURVEY AND INFORMATION OF RECORD. IT IS NOT WARRANTED THAT THEY ARE EXACTLY LOCATED, NOR THAT ALL UNDERGROUND CONDUITS OR OTHER STRUCTURES ARE SHOWN ON THIS PLAN. *CONTACT DIGSAFE 811 PRIOR TO ANY EXCAVATION.
4. THERE ARE WATER SPIGOTS LOCATED THROUGHOUT THE CEMETERY BUT THE SURVEYOR DID NOT FIND ANY INFORMATION REGARDING THE LOCATION OF THE WATER LINE.
5. THE SUBJECT LAND AS SHOWN LIES WITHIN ZONE X, AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN, AS INDICATED ON PANEL 417E FOR THE TOWN OF ARLINGTON, COMMUNITY NO. 250177, HAVING AN EFFECTIVE DATE OF JUNE 4th, 2010.
6. THE CURRENT RECORD OWNER IS THE TOWN OF ARLINGTON. FOR LOCUS DEED, SEE BOOK 3929 PAGE 361 RECORDED AT THE MIDDLESEX SOUTH COUNTY REGISTRY OF DEEDS.
7. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE SEARCH AND MAY NOT SHOW OR REVEAL ANY FACTS THAT WOULD BE DISCLOSED BY ONE.
8. THIS PLAN IS NOT INTENDED TO REPRESENT A FULL BOUNDARY RETRACEMENT SURVEY.

LEGEND

▦	CATCH BASIN
◯	DECIDUOUS TREE
❀	CONIFEROUS TREE
--60--	INDEX CONTOUR
--59--	INTERMEDIATE CONTOUR
+58.7	SPOT GRADE
tw=	TOP OF WALL ELEVATION
bw=	BOTTOM OF WALL ELEVATION
n/a	INVERT NOT AVAILABLE
EOP	EDGE OF PAVEMENT
EOC	EDGE OF CONCRETE

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Mt. Pleasant Cemetery
70 Medford Street
Arlington, MA

COMMONWEALTH OF MASSACHUSETTS
JAMES P. HORGAN
No. 50302
PROFESSIONAL LAND SURVEYOR

10-01-18

JAMES P. HORGAN - P.L.S. NO. 50302
REGISTERED PROFESSIONAL
LAND SURVEYOR FOR
SAMIOTES CONSULTANTS, INC.

REVISION

LIMITED TOPOGRAPHIC PLAN OF LAND

JOB # 17181.01	T-1.1
DATE: 01-17-18	
SCALE: 1"=10'	
DRAWN BY: CY	
REVIEWED BY: JPH	

FILE: 17181 MT.PLEASANT CEMETERY WS.DWG

Structures North
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27 September 2018

Michelle de Tarnowsky
Ray Dunetz Landscape Architecture
179 Green Street
Boston, MA 02130

Reference: Old Burying Ground, Arlington, MA
Structural Conditions Assessment

Dear Michelle:

We have completed a visual survey of the five mount tombs at the Old Burying Ground in Arlington, Massachusetts. For the purposes of this report the Pleasant Street runs east-west.

General Description

Dating from 1732, the Old Burying Ground is located in Arlington's Town Center on Pleasant Street near Massachusetts Avenue.

The east edge of the Burying Ground abuts a walkway which runs along the rear of the First Parish Unitarian Universalist Church. The northeast corner and north property line front Peg Spengler Way and a parking lot shared by Robbins Library and the Whittemore-Robbins House. This area of buildings is also known as Arlington's 'Civic Block'. The western end of the burying ground abuts property owned by Verizon. The existing brick building on this parcel is over 3 stories in height, has a large footprint and casts a long shadow over the burying ground.

Noted Building Conditions and Repair Recommendations

The following conditions were noted at the Old Burying Ground, for which we have the following recommendations and estimated construction costs in parentheses:

Pleasant Street Wall

Overall the existing stone wall is in good condition with areas requiring typical maintenance repairs. The length of the wall adjacent to the Pleasant Street sidewalk has some open mortar joints. The larger openings should be filled with stone chinkers and dry-packed with mortar. The rest of open and cracked mortar joints should be cut and pointed with a compatible mortar. ($4,500 to $7,500)

On the east side of the entrance to the burying ground and along the curved section of the wall, there are four coping stones that have shifted or fallen off the wall and should be re-set. The broken coping stone should be pin repaired before being reinstalled. ($2,800 to $4,700)

There are also open mortar joints on this section of wall that should be cut and pointed with a compatible mortar. ($2,500 to $4,400)

Church/Northeast Wall

The boundary wall along the northeast edge of the burying ground is built of both brick and stone sections and there are four tombs which are adjacent to the wall. The tomb front walls are in good condition but the masonry side walls have shifted and should be reset. Three of the four metal tomb doors have broken or damaged hinges that should be repaired. ($7,300 to $12,200)

There is extensive damage and movement of the brick and stone boundary wall. The stones and bricks in the southern section of the wall have shifted. To the north of the section of the perimeter without a wall, the brick wall is leaning outward and the bricks are loose and shifted. At the northeast corner, the stone wall is bulging outward and the metal ties have broken. The stone and brick sections of northeast wall should be dismantled to sound masonry and reset to match the existing construction. ($110,000 to $182,800)

Robbins Library & Whittemore Robbins House / Northwest Wall

There is a stone wall approximately five feet tall between the northeast corner and the east end of the tombs. Behind the tombs the height of the wall gradually decreases to approximately three feet when measured from outside the burying ground. At the west end of the burying ground the wall material changes to brick masonry. The portion of the stone wall located at the rear side of the mound tombs has been determined to be the structural support of the tomb roof slabs.

The stone wall is in poor condition for 75% of its length with areas of loose, missing and bulging masonry. The areas that appear to be sound have a substantial moss growth in the mortar joints, which typically indicates that the inner mortar has deteriorated to sand. The brick masonry is in a similar state of deterioration as the majority of it is buckled to the point of possible collapse. The full length of the wall should be dismantled and reconstructed. If the reconstruction is to be completed in phases, it is recommended that the brick masonry portion of the wall is completed first. At the rear of the tombs, the tombs will be opened during the reconstruction of the stone masonry. All efforts should be taken to protect the remains within the tomb. If the remains are in danger of falling debris, the tomb should be entered and partially filled with sand to cover and protect the tomb contents. The marble tomb plaques set in the brick wall should be reset at their original locations and the trees growing on both sides of the wall should be removed. ($903,800 to $1,506,300)

There are 15 tombs that line the western half of the boundary wall. The western tomb has a separate front wall, which is slightly leaning backwards. The front stone wall row of tombs are in good condition with minimal movement of the upper stones. The mortar joints of all the tomb walls should be cut and pointed with a compatible mortar. There is a small opening into the western row tomb that should be filled with chinker stones and mortar. The eastern tomb end wall is retaining a small amount of soil and bowing outward. The end wall should be dismantled and reset. ($150,000 to $250,000)

Small movements in the tomb doors allowed for viewing of the interior of two tombs. Some wet mortar joints were noted along with open mortar joints in the rear stone wall. Unless additional work is to be completed at the tombs, such as the resetting or replacement of the doors, no work is needed at this time. It should be noted that it is unclear if the rear wall of the tombs are the same as the boundary wall. Great care should be taken when dismantling the boundary wall to prevent any debris from entering the tombs. If the walls are the same, the tomb and its contents should be protected during the reconstruction of the wall.

Western Boundary Wall

The western wall appeared to be in good condition and no work is required.

Report Limitations

This report is a summary of readily visible observations conducted during a single site visit to the property. This report is strictly limited to structural considerations noted.

If you have any questions regarding this report, please do not hesitate to contact this office.

Respectfully Yours,
Structures North Consulting Engineers, Inc.

Stephanie Davis, EIT

John M Wathne, PE

Structures North
CONSULTING ENGINEERS, INC.

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T 978.745.6817 | F 978.745.6067
www.structures-north.com

11 July 2018

Michelle de Tarnowsky
Ray Dunetz Landscape Architecture
179 Green Street
Boston, MA 02130

Reference: - Mount Pleasant Cemetery, Arlington, MA
Structural Conditions Assessment

Dear Michelle:

We have completed a visual survey of the five mount tombs at the Mount Pleasant Cemetery in Arlington, Massachusetts. For the purposes of this report the doors to the Mount Pleasant Cemetery tombs face south.

General Description

The row of five mound tombs are constructed with stone masonry walls with stone slab ceilings. The top of the tombs have been covered with soil and a brick veneer wall installed at the west side wall and the front wall extended at the east side with newer granite stone units. The front wall for each tomb are three large granite stone units, one on each side of the door and third above. The original metal doors are located at all but one tomb opening, which has been infilled with concrete or parged masonry.

Noted Building Conditions and Repair Recommendations

The following conditions were noted at the Mount Pleasant Cemetery mound tombs, for which we have the *following recommendations and estimated construction costs in parentheses*:

- The brick masonry at the west side is cracked and the granite coping stones are shifted. *The brick masonry should be reconstructed and the coping stones reset.* ($4,500 to $6,000)

- The mortar joints between the tombs on the front wall are open and should be cut and pointed with a compatible mortar. ($500 to $1,000)

- At the two western tombs, the upper stone has shifted outward. The stone at the second tomb from the west has been resent every 2-3 years recently because of continued movement. *The stones should be removed and the tops of the tombs exposed. The roof slab mortar joints should be cut and pointed with a compatible mortar and any space between the roof slab and the*

upper front wall stones should be filled with mortar and chinker stones based upon the width of the gap before the soil is replaced. The upper stones should be re-set with pins between the lower and upper stones of the wall as well as ties back to the top of the roof slab units to prevent future movement. ($7,000 to $9,500)

- The metal door hinge straps are broken at the bottom of all doors and the top at the second door from the east. *The metal hinges should be repaired or replaced so that the doors are operable, close properly and locked.* ($2,800 to $4,700)

- At the eastern tomb, the base of the metal door is rusted to create a small opening. There is surface rust on all of the doors. *The metal doors should be removed, repaired, cleaned and painted with a rust-inhibiting paint.* ($3,400 to $5,600)

Report Limitations

This report is a summary of readily visible observations conducted during a single site visit to the property. This report is strictly limited to structural considerations noted.

If you have any questions regarding this report, please do not hesitate to contact this office.

Respectfully Yours,
Structures North Consulting Engineers, Inc.

Stephanie Davis, EIT

John M Wathne, PE -

Tree Specialists, Inc.
Conservation | Preservation | Restoration

140 Washington Street
Holliston, Massachusetts 01746
T 508.429.8733 F 508.429.7991
www.treespecialists.com

Date June 28, 2018

Site **Arlington Old Burying Ground**

To Ray Dunetz, Ray Dunetz Landscape Architecture (RDLA)

From Barbara Keene Briggs

Subject Tree Assessment and Recommendations

Assignment
On January 22, at the request of Ray Dunetz, RDLA, Barbara Keene Briggs and David Ropes, certified arborists with Tree Specialists, Inc., conducted a site visit to the Old Burying Ground on Pleasant Street in Arlington. Our goal was to evaluate the condition of trees and provide recommendations that will facilitate the master planning and current maintenance program.

We agreed that my assignment was to conduct a *Level 2 Visual Tree Assessment,* as described in the American National Standards Institute (ANSI) publication "A300 (part 9)". This includes a 360-degree, ground-based visual inspection of the tree crown, trunk, trunk flare, above-ground roots and site conditions around the tree in relation to targets. It does not include any aerial inspection, or the use of decay detection equipment or tissue analysis.

1. Trees and standing remnants of trees will be assigned a tree identification number that will correspond to the inventory and site map provided by RDLA.
2. Evaluate the condition of the ground plane, and identify management issues as they relate to the stabilization and perpetuation of the feature.
3. The inventory will include an entry for each tree, as follows:
    - Map Identification Number
    - Identification of genus and species
    - Size – DBH and height
    - Condition assessment for health and structure
    - Recommendations rated as high, medium and low priority

Limits of Assignment
The assessment is based solely on our visual inspection conducted on January 22, 2018. No special diagnostic equipment was used and no climbing was performed. Since the assessment was conducted during the dormant season, a follow up visit during the summer months is necessary to confirm the assigned health rating for each tree. The follow up visit was performed by David Ropes on June 20, 2018.

Observations and Recommendations
Traditional New England landscapes have a unique charm, and historic burial grounds are an essential component of many "village" landscapes. The aura of antiquity is often enhanced by the presence of mature trees, and the Arlington OBG exemplifies this. As is the case with many municipal landscapes, the level of tree care has not kept up with care needed to maintain these trees, and many are in need of stabilization work. Our regional urban forests have always been met with challenges – diseases such as Dutch elm disease, and environmental conditions like drought, snow, ice, and hurricanes have ravaged our area, greatly changing the character and composition of our regional tree cover.

In the last decade we have seen a proliferation of new challenges – foliar feeding by *European Winter moth*, *Hemlock Woolley adelgid* and perhaps most significantly, drought. All of these factors are at play in the OBG landscape. For some of the trees it is too late to reverse the present state of decline. Still, the collection does contain valuable specimens, and removal of the numerous poor quality trees will only serve to enhance the presence of the remaining individuals.

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www.treespecialists.com

As with any comprehensive tree management program, the ideal approach would be multi-faceted:

Selective Removal
Numerous trees are in poor condition, and cannot be remediated. In some cases, large dead or structurally weakened limbs increase the risk of a failure event. These are considered *High Risk* specimens that might pose a threat to visitor safety or abutting properties. In addition, we are recommending the selective removal of "volunteer" trees that are displacing stonewalls around the perimeter. Though the inventory only includes trees, there are several shrub masses that are also growing into the walls and should be removed.

Maintenance Pruning
Modern pruning practice requires are applied to meet specific goals and objectives:
Mitigate Risk – removal of dead, dying and/or structurally weakened limbs that are in danger of falling and/or striking people, property or other *targets*.
Manage Health – removal of limbs that are dead, diseased, weak, or otherwise deleterious for the growth and development of the tree.
Manage structure – This includes the removal of "healthy" living branch structures to:

- aid in the development of good plant architecture
- decrease weight and strain on major limbs to reduce susceptibility to structural failure
- reduce or manage plant shape or size
- provide clearance for buildings or other infrastructure

Retrenchment pruning
This is an extreme form of reduction pruning that is applied under very specific conditions to retain individual trees that might otherwise need to be removed due to safety, insect/disease infestation, or infrastructure conflicts.

Plant Health Care
All trees benefit from the implementation of *plant health care* treatments to improve growing conditions, including:

- Spray or injection treatments to control insect and disease pests - as noted in the inventory.
- Soil modification and amendment to improve root health and tree longevity. Our regional soils are often poor quality, with low fertility and moisture retention. This is exacerbated on sites that practice annual leaf pick-up as this breaks the nutrient cycling process which is critical to sand-based soils. We recommend a variety of tactics to address this:
    - Soil sampling and lab testing to determine macro/micro nutrient content, soil pH, textural composition, and depth.
    - Use of composted hardwood mulches wherever possible.
    - De-compaction and sub-surface integration of organic matter when appropriate.
    - Application of bio-stimulant fertilizers and hygroscopic humectants to improve soil biotics and moisture retention.

Tree Risk Management
The cumulative effect of tree species, visible defects, and relevant site conditions are all considered when quantifying the potential for tree failure and damage to persons or property. **It is important to note that there is currently no tool or technology that allows for the prediction of tree failure.** Trees that are identified as low risk do possess a potential for failure, and trees that are designated as high risk may not fail in the short term. Still, an organized, proactive tree management program based on the results of a formal Tree Assessment is the best way to stabilize the collection and reduce the occurrence of tree failure over the long term.

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To help organize data into meaningful recommendations, three levels of priority have been defined:

High Priority

- *High-risk* trees = defect + high value target + high level of occupancy. Also listed as *High Priority* are trees that are currently displacing historic infrastructure, specifically the perimeter wall.

Medium Priority

- *Medium risk* trees = defects + high value target + medium level of occupancy.
- Stabilization work on significant specimens.
- Trees that may be a threat to the historic infrastructure in the near or medium term.

Low Priority

- Stabilization work on lower risk trees that are currently in good condition or pose minimal threat to people or the historic infrastructure.

Individual Tree Assessment (see corresponding map)

Tree ID #	Tree Species	DBH	Height	Health / Structure	Condition and/or Recommendations	Priority H/M/L
1	Flowering Cherry *Prunus sp.*	11"	18'	G/G	Co-dominant stem. Maintenance prune for crown cleaning.	L
2	Crabapple *Malus sp.*	12"	25'	F/F	Maintenance prune for crown cleaning.	M
3	Crabapple *Prunus sp.*	11"	25'	F/F	Maintenance prune for crown cleaning.	L
4	Flowering Cherry *Prunus sp.*	7"	12'	P/P	Included bark in codominant stem. Maintenance prune for crown cleaning.	M
5	Ash *Fraxinus sp.*	8"	30'	Dead	Small volunteer growing in a low retaining wall and granite post. Cut down.	M
6	Sugar Maple *Acer saccharum*	5"	20'	G/G	Growing through fence and into wires. Cut down.	M
7	Norway Maple *Acer platanoides*	4"	15'	G/G	Growing against fence and a granite post. Cut down.	M
8	Euonymus sp.	4"	5'	Dead	Invasive volunteer at base of post. Cut down	M
9	Black Walnut *Juglans nigra*	21"	50'	F/P	Asymmetrical form, girdling root. Cut girdling root and maintenance prune for end weight reduction on the long heavy limbs.	H
10	Norway Maple *Acer platanoides*	16"	40'	G/F	Invasive species. Many large pruning wounds. Not an appropriate species growing close to historic infrastructure and monument markers due to their invasive roots. Cut down.	M
11	Black Walnut *Juglans nigra*	16"	50'	F/F	Many large wounds. Low live crown ratio.	M
12	Elm *Ulmus sp.*	6"	28'	P/P	Volunteer tree growing into the wires. Cut down.	M
13	Norway Maple *Acer platanoides*	17"	40'	F/F	Growing against wall. Cut down.	M
14	Ash *Fraxinus sp.*	4"	18'	P/P	Volunteer growing into wires. Cut down.	M
15	Norway Maple *Acer platanoides*	24"	35'	P/P	Invasive species, growing into wires, numerous cavities. Cut down. High risk tree.	H
16	Norway Spruce *Picea abies*	21"	55'	P/G	Thin, chlorotic, dying back. Test soil and treat based on soil test results. Could be retained in the short term, but likely to continue decline.	M
17	Pin Oak *Quercus palustris*	12"	32'	G/G	Growing against wall and into wires. Cut down.	M
18	Norway Maple *Acer platanoides*	21"	25'	P/P	Dieback, cavities, high risk tree. Cut down.	H
19	Elm - *Ulmus sp.*	7.5"	20'	F/F	close to wall – cut down	M

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20	Norway Maple *Acer platanoides*	14″	30′	F/F	Invasive species growing close to wall, dieback. Cut down	M
21	Sugar Maple *Acer saccharum*	10″	25′	P/P	Near dead. Cut down.	M
22	Elm *Ulmus sp.*	15″	40′	P/P	Dieback in canopy, mulberry sprouts growing into wall and establishing into a conflict issue – remove tree	H
23	Crabapple *Malus sp.*	5″	12′	G/P	Close to wall. Maintenance prune.	L
24	Black Walnut *Juglans nigra*	14″	35′	G/G	Growing adjacent wall – may be retained - consult with mason regarding conflict with wall renovation	H
25	Elm *Ulmus sp.*	11″	35′	P/F	Growing against wall. Cut down.	M
26	Elm *Ulmus sp.*	16″	35′	Dead	Growing against wall. Cut down.	M
27	Crabapple *Malus sp.*	7″	10′	P/P	Multistem volunteer with fireblight, growing into wall. Cut down.	M
28	Crabapple *Malus sp.*	7″	10′	Dead	Volunteer with fireblight, growing into wall. Cut down.	M
29	Sugar Maple *Acer saccharum*	16″	60′	F/P	Growing adjacent wall – may be retained - consult with mason regarding conflict with wall renovation	H
30	Sugar Maple *Acer saccharum*	22″	60′	F/G	Growing close to wall. Maintenance prune.	M
31	Crabapple *Malus sp.*	10″	20′	F/F	Maintenance prune.	M
32	Crabapple *Malus sp.*	6″	18′	F/F	Growing into wall, but a small, slow growing species – may be retained.	M
33	Crabapple *Malus sp.*	7″	15′	F/F	Maintenance prune.	L
34	Flowering Cherry *Prunus sp.*	8.5″	15′	F/F	Maintenance prune.	L
35	Flowering Cherry *Prunus sp.*	10″	15′	P/P	Maintenance prune.	L
36	Sugar Maple *Acer saccharum*	32″	45′	P/P	Lost top –cavity -some portions are vigorous – trunk affecting grave stone. Crown reduction/structural bracing needed to retain tree.	H
37	White Pine *Pinus strobus*	29″	55′	G/G	Maintenance prune for end weight reduction.	M
38	Hemlock *Tsuga Canadensis*	24″	60′	F/F	Scale/Adelgid, broken limb. Prune out deadwood and broken limb. Treat for insects and boost cultural care.	M
39	Sugar Maple *Acer saccharum*	37″	55′	G/G	Maintenance prune.	L
40	Red Maple *Acer rubrum*	20″	40′	F/F	Multi stemmed/stump sprout. Maintenance prune.	M
41	Sugar maple *Acer saccharum*	21″	55′	F/F	Numerous cavities, girdling root. Cut girdling root and maintenance prune for end weight reduction.	M
42	White Pine *Pinus strobus*	19″	60′	G/G	Maintenance prune for end weight reduction.	M
43	Sugar Maple *Acer saccharum*	35″	55′	F/F	Numerous cavities, deadwood. Maintenance prune.	H
44	White Pine *Pinus strobus*	25″	65′	G/G	Maintenance prune, end weight reduction.	M
45	White Pine *Pinus strobus*	35″	65′	G/G	Maintenance prune, end weight reduction.	M
46	Elm *Ulmus sp.*	19″	35′	F/F	Deadwood. Maintenance prune for deadwood only.	M
47	Ash *Fraxinus sp.*	13″	45′	F/F	Maintenance prune. Assess health condition is summer.	M
48	White Pine *Pinus strobus*	27″	55′	G/G	Maintenance prune, end weight reduction.	M

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49	Pin Oak *Quercus paulustris*	37”	50’	P/P	Significant deadwood – pattern of decline suggests Shoestring Root Rot. Prune and boost cultural practices to prolong life.	H
50	Black Maple *Acer nigrum*	23”	45’	F/G	Deadwood. Maintenance prune for deadwood only.	M
51	Eastern Arborvitae *Thuja occidentalis*	25”	25’	P/F	Old character tree. Maintenance prune for crown cleaning and crown reduction.	M
52	White pine *Pinus strobus*	29”	60’	G/G	Stress crack. Maintenance prune for end weight reduction.	M
53	White pine *Pinus strobus*	20”	60’	G/F	Internal decay. Decay on surface roots. Prune for end weight reduction.	M
54	Hemlock *Thuja canadensis*	21”	55’	P/P	Decay on buttress roots, weak. Scale/Adelgid infestation. Prune out deadwood. Treat for insects and boost cultural care.	M
55	Sugar Maple *Acer saccharum*	37”	55’	G/G	Beautiful tree! Maintenance prune for deadwood only.	M
56	White Pine *Pinus strobus*	19”	25’	G/F	Asymmetrical, prune heavy side for end weight reduction.	M
57	Sugar Maple *Acer saccharum*	19”	45’	P/F	Dieback. Maintenance prune.	M

Summary
This site possesses many great features, including a “core canopy” of mature and healthy trees. The removal of high risk and poor quality trees will benefit remaining trees as well as other features of the landscape, including historic stone work, turf quality, and overall appearance. The recommended combination of tree care and selective removal represents the best approach for managing both the canopy resource and the landscape as a whole.

Please do not hesitate to call with any questions.

Sincerely,

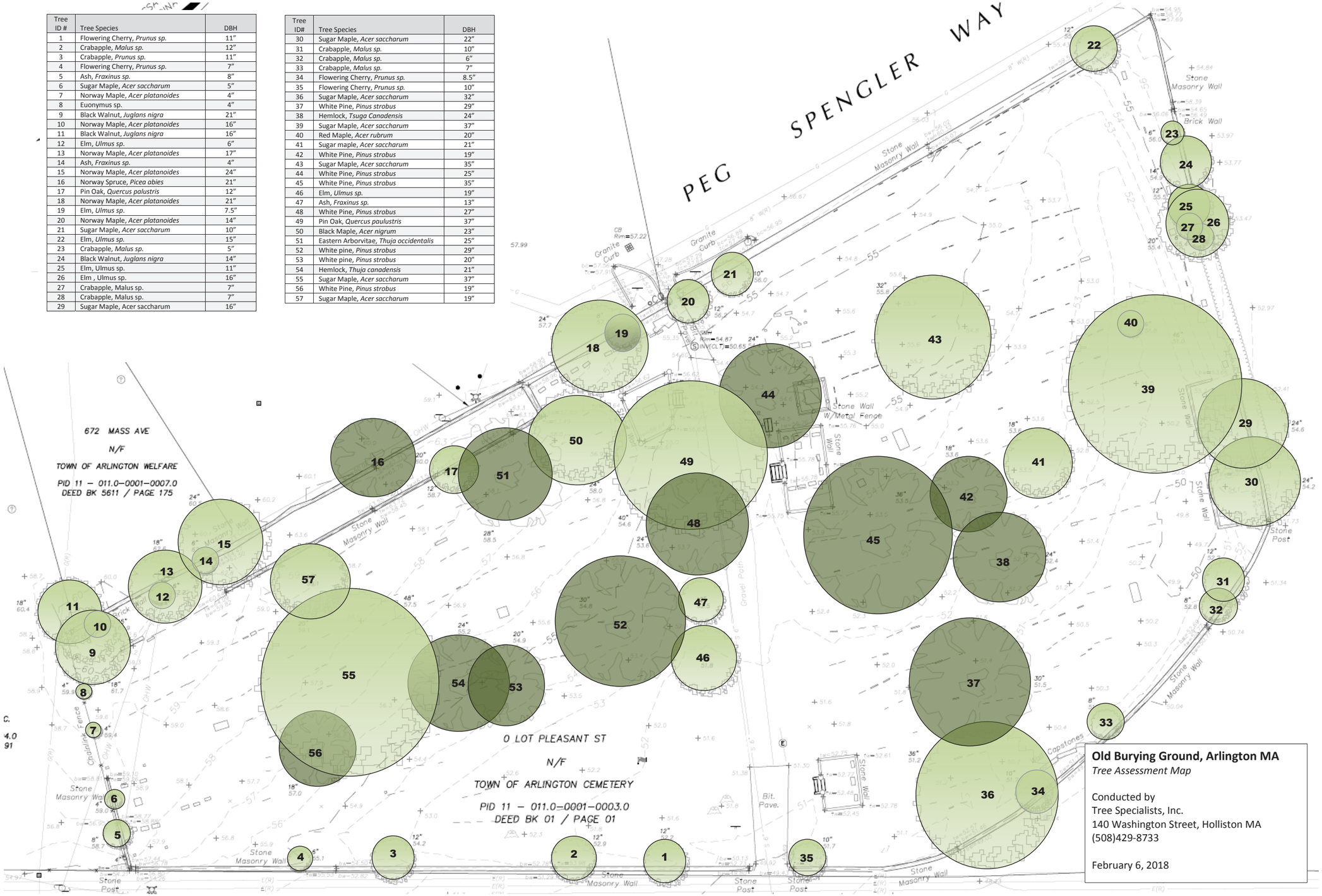
Barbara K. Briggs

Barbara Keene Briggs
MAA Certified Arborist #1899
NE-ISA Certified Arborist #0863A

Attachment
Annotated site map showing the map #’s and tree locations that correspond to the assessment above

Tree ID #	Tree Species	DBH
1	Flowering Cherry, *Prunus sp.*	11″
2	Crabapple, *Malus sp.*	12″
3	Crabapple, *Prunus sp.*	11″
4	Flowering Cherry, *Prunus sp.*	7″
5	Ash, *Fraxinus sp.*	8″
6	Sugar Maple, *Acer saccharum*	5″
7	Norway Maple, *Acer platanoides*	4″
8	Euonymus sp.	4″
9	Black Walnut, *Juglans nigra*	21″
10	Norway Maple, *Acer platanoides*	16″
11	Black Walnut, *Juglans nigra*	16″
12	Elm, *Ulmus sp.*	6″
13	Norway Maple, *Acer platanoides*	17″
14	Ash, *Fraxinus sp.*	4″
15	Norway Maple, *Acer platanoides*	24″
16	Norway Spruce, *Picea abies*	21″
17	Pin Oak, *Quercus palustris*	12″
18	Norway Maple, *Acer platanoides*	21″
19	Elm, *Ulmus sp.*	7.5″
20	Norway Maple, *Acer platanoides*	14″
21	Sugar Maple, *Acer saccharum*	10″
22	Elm, *Ulmus sp.*	15″
23	Crabapple, *Malus sp.*	5″
24	Black Walnut, *Juglans nigra*	14″
25	Elm, Ulmus sp.	11″
26	Elm , Ulmus sp.	16″
27	Crabapple, Malus sp.	7″
28	Crabapple, Malus sp.	7″
29	Sugar Maple, Acer saccharum	16″

Tree ID#	Tree Species	DBH
30	Sugar Maple, *Acer saccharum*	22″
31	Crabapple, *Malus sp.*	10″
32	Crabapple, *Malus sp.*	6″
33	Crabapple, *Malus sp.*	7″
34	Flowering Cherry, *Prunus sp.*	8.5″
35	Flowering Cherry, *Prunus sp.*	10″
36	Sugar Maple, *Acer saccharum*	32″
37	White Pine, *Pinus strobus*	29″
38	Hemlock, *Tsuga Canadensis*	24″
39	Sugar Maple, *Acer saccharum*	37″
40	Red Maple, *Acer rubrum*	20″
41	Sugar maple, *Acer saccharum*	21″
42	White Pine, *Pinus strobus*	19″
43	Sugar Maple, *Acer saccharum*	35″
44	White Pine, *Pinus strobus*	25″
45	White Pine, *Pinus strobus*	35″
46	Elm, *Ulmus sp.*	19″
47	Ash, *Fraxinus sp.*	13″
48	White Pine, *Pinus strobus*	27″
49	Pin Oak, *Quercus paulustris*	37″
50	Black Maple, *Acer nigrum*	23″
51	Eastern Arborvitae, *Thuja occidentalis*	25″
52	White pine, *Pinus strobus*	29″
53	White pine, *Pinus strobus*	20″
54	Hemlock, *Thuja canadensis*	21″
55	Sugar Maple, *Acer saccharum*	37″
56	White Pine, *Pinus strobus*	19″
57	Sugar Maple, *Acer saccharum*	19″



Old Burying Ground, Arlington MA
Tree Assessment Map

Conducted by
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Maps

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